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Pesticide Effects on Wildlife

1967-1976 Bibliography of Abstracts

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MANITOBA
DEPARTMENT OF MINES, RESOURCES
& ENVIRONMENTAL MANAGEMENT

PESTICIDE EFFECTS ON WILDLIFE

1967 - 76 Bibliography of Abstracts

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Report 77-1

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Pesticide Effects on Wildlife.
1967 - 76 Bibliography of Abstracts.

Manitoba Dept. Mines, Resour. Environ. Manage.,
Environ. Res. Dev. Branch. Rep. 77-1. 153 pp.

ABSTRACT

Abstracts were assembled of scientific reports dated 1967 - 1976 and relevant to Manitoba-used pesticides or to Manitoba wildlife, and indexes were prepared of chemicals and species involved. Main unresolved problems, gaps in present knowledge, and topics in need of future research are briefly discussed.

TABLE OF CONTENTS

Introduction 1
Methods 3
Discussion and Conclusions 5
Literature Cited 6
Abstracts 7
Index of common and scientific names of animals 110
Index of common and technical names of pesticides 134

INTRODUCTION

This report assembles abstracts of publications from 1967 to 1976 presenting information about effects of pesticide use on wildlife species or populations.

Post-war years have witnessed a rapid increase in the use of pesticides, and in numbers of various compounds used to combat pests. It soon became apparent that heavy applications, indiscriminate use, and indeed, even 'normal' or 'recommended' uses may constitute environmental hazard. Broad ramifications of pesticide effects in the environment were pointed out in the pioneering works of Carson (1962) and Rudd (1964). These authors addressed primarily the use of DDT and related organochlorines. However, many problems of pesticide use in relation to wildlife still remain unresolved, and this applies also to the more recent carbamate and organophosphate chemicals. These problems concern mainly the following impacts of pesticides on wildlife:

(1) Biological concentration of toxic residues in animals at upper levels of the food chain.
(2) Acute toxicity to non-target organisms.
(3) Effects of continued exposure to non-lethal levels of pesticides.
(4) Effects of metabolites of the originally used compounds.
(5) Synergistic effects of different pesticides when used in conjunction.
(6) Effects of pesticide-induced habitat changes on wildlife populations.

As early as 1967, the Department of Mines and Natural Resources issued a report entitled, "The Use of Pesticides in Manitoba and Their Effects on Wildlife" (McGrath, 1969), which summarized the situation during the sixties. The report lists some 12 chemicals then in use, mainly organochlorines. In the years that followed, proliferation of new compounds, various formulations and different trade names created a veritable maze of pest control products.

In the province of Manitoba, the Department of Agriculture is charged with the administration of The Pesticides and Fertilizers Control Act. When reviewed in the fall of 1976, publications available through the Department of Agriculture recommended for various uses no less than 109 different active ingredients (chemicals). Seventy-three of these ingredients were recommended in the most recent publications (dated 1975 and 1976).

Although all the recommended chemicals may not be in general use, there is a valid concern about the extraordinary proliferation of pest control products and their extensive use. Inasmuch as species-specific pest control products are not available, the need for such a multitude of chemicals is open to question. To be able to reduce the number of chemicals, it is essential to pool existing information. This report is intended as a move in that direction.

We hope that this bibliography will assist those charged with making decisions on pesticide use to consider the need for treatment in terms of environmental costs or benefits, and where appropriate, choose the best suited, and above all, the safest product or formulation.

METHODS

Main sources of titles for this bibliography were the following abstracting periodicals: Biological Abstracts, Pollution Abstracts, Wildlife Review, and Environmental Abstracts. In addition to a manual search of these, a search was commissioned of the data bases available through CAN/OLE computer services of Canadian Institute for Scientific and Technical Information, National Research Council of Canada. "Literature Cited" sections of the reviewed papers provided further sources of references.

In order to cope with the mass of published reports on the subject, the scope of this bibliography is limited to include only papers that meet the following criteria:

(1) Report was published during the period 1967 - 1976. Earlier papers are concerned mostly with DDT and its derivatives, compounds that are now being phased out because of the danger they pose owing to their persistence and cumulative properties. Much of the early wildlife-pesticides related work has been reviewed in the excellent study by Rudd and Genelly (1956).

(2) Report concerns species of wildlife that occur in Manitoba. The term "wildlife" is used as defined by The Manitoba Wildlife Act: "... a vertebrate animal of any species or type excluding fishes that is wild by nature in the province."

(3) Report pertains to chemicals recommended for use in Manitoba. Source of the list of such chemicals were publications distributed by the Manitoba Department of Agriculture as of August, 1976.

(4) Discussion is not limited to DDT and related organochlorines. If a paper dealt solely with DDT or its derivatives, it was not included.

(5) Findings are applicable to wildlife in its natural habitat. Purely physiological laboratory studies were excluded.

The abstracts presented here are mostly full or modified (usually abridged) author's abstracts as they appeared in the original paper or in the abstracting journal. No attempt was made to interpret, evaluate, or judge the author's conclusions.

The majority of the papers were located in original form and reviewed for chemicals/active ingredients, and for wildlife species. Thus, the indexes of this report may contain chemicals or wildlife that are not specifically mentioned in the abstracts. Pesticides indexed without an asterisk are not on the list of those recommended in Manitoba, but were subjects of papers that do include recommended ones. The same applies to some of the wildlife species included in the index. Polychlorinated biphenyls (PCBs), although not used for pest control, have been included in many residue analyses, owing to their structual similarity to organochlorines. They are also indexed.

Abstracts are arranged in alphabetical order by author's name, and numbered. The numbers were used for indexing, i.e. all numbers following a species or chemical name refer to the numbers assigned to abstracts in the text. Scientific names are used throughout the species index, except for domestic animals where only common names are employed. Where a large number of references is involved, the reader is referred from the common to the scientific name.

The nomenclature follows Jones et al. (1975) for mammals, Godfrey (1966) or Peterson et al. (1961) for birds, and Conant (1958) for amphibians and reptiles.

DISCUSSION AND CONCLUSION

During the review of pesticide papers for this bibliography, it became obvious that not all aspects of the pesticide-wildlife relationships are covered to the same extent.

There are many papers which report simply contents of pesticide residues in tissues of various animals. Abundant literature exists on lethal doses of chemicals to the target species, and to such common laboratory animals as rats, mice, rabbits or dogs. Fewer reports address the side effects of pesticides and most of these relate to laboratory investigations. Still fewer report mortalities of animals in the field, after pesticide application in recommended doses. And there is conspicuous dearth of data on long-term and indirect effects of routine pesticide applications on non-target species and populations.

While recent years have seen more reports on transport, metabolism, and breakdown of pesticides in organisms or in the environment, many unanswered questions regarding effects on non-target wildlife remain: mortality, chronic effects of repeated exposures, responses of predator species to pesticide control of their prey, and long-term effects of habitat changes induced by use of the chemicals. These are the difficult, but most needed areas to which future research ought to be directed.

Until sufficient information of this kind has been provided, it would be only prudent to curtail rather than expand the number of various chemicals and compounds; where the need for chemical control of a pest is unequivocally established, those pesticides whose side effects are least harmful should be preferred

LITERATURE CITED

Carson, R. 1962. SILENT SPRING. Houghton-Mifflin Co., Boston. 368 pp.

Conant, R. 1958. A FIELD GUIDE TO REPTILES AND AMPHIBIANS. Houghton-Mifflin Co., Boston. 366 pp.

Godfrey, W. E. 1966. THE BIRDS OF CANADA. Nat. Mus. Canada Bull. 203. Biol. Ser. 73. 428 pp.

Jones, J. K., Jr., D. C. Carter, and H. H. Genoways. 1975. REVISED CHECK-LIST OF NORTH AMERICAN MAMMALS NORTH OF MEXICO. Occas. Pap. Mus. Texas Tech. Univ. 28. 14 pp.

McGrath C.A. 1969. THE USE OF PESTICIDES IN MANITOBA AND THEIR EFFECTS ON WILDLIFE. Manitoba Dept. Mines Nat. Resour. 22 pp. Mimeo

Peterson, R., G. Mountfort, and P. A. D. Hollom. 1961. DIE VOGEL EUROPAS. Fourth Ed. Verlag Paul Parey, Hamburg. 385 pp.

Rudd, R. L. 1964. PESTICIDES AND THE LIVING LANDSCAPE. Univ. Wisconsin Press, Madison. 320 pp.

------------, and R. E. Genelly. 1956. PESTICIDES: THEIR USE AND TOXICITY IN RELATION TO WILDLIFE. California Dept. Game and Fish, Game Manage. Branch Game Bull. 7. 209 pp.

1. Adams, W. J., and H.H. Prince. 1972.
SURVIVAL AND REPRODUCTION OF RING-NECKED PHEASANTS CONSUMING TWO MERCURIAL FUNGICIDES.
Pages 306 - 317 *in* Hartung, B., and B.D. Dinnan, eds. Environmental mercury contamination. Ann Arbor Sci. Publ. Inc. Ann Arbor: 348 pp.

The effects of two mercurial fungicides, methyl mercuric dicyandiamide and phenylmercuric acetate on the survival and reproduction of hen pheasants are studied. There was no reduction in egg production due to phenylmercury treatments. Both methyl and phenyl mercury compounds affected hatchability.

2. Adley, F.E., and D.W. Brown. 1972.
MERCURY CONCENTRATION IN GAME BIRDS. STATE OF WASHINGTON 1970 - 1971.
Pestic Monit. J. 6(2): 91 - 93.

A brief report dealing with the presence of mercury in the livers of game birds. Two hundred and forty-six specimens of seven game species were contributed by Washington hunters during October, 1970 to January, 1971 and four during May, 1971. Muscle samples submitted with some of the liver specimens were also analyzed. The highest mercury concentrations were found in mergansers.

3. Agalides, E. 1971.
THE EFFECT OF ORGANO-PHOSPHORUS INSECTICIDES ON THE NERVOUS SYSTEM OF VERTEBRATES.
General Dynamics Corp. Pomona Operations, Electro Dynamic Div., Advanced Techniques Section, Advanced Sensor Lab., CA 270 - 277.

No abstract located.

4. Anas, R. E., and A. J. Wilson Jr. 1969.
ORGANOCHLORINE PESTICIDES IN FUR SEALS.
Pestic. Monit. J. 3(4): 198 - 200.

Samples of liver and brain tissues from 30 northern fur seals (*Callorhinus ursinus*) and seven fur seal fetuses that were collected on the Pribilof Islands, Alaska, in 1968 and off the Washington coast in 1969, were analyzed for organochlorine pesticides. These compounds were found in all of the fur seals and in three of the fetuses. DDT and its derivatives were the major chemicals mentioned, however, dieldrin was found in three of the liver samples.

5. Anas, R. E., and A. J. Wilson Jr. 1970.
ORGANOCHLORINE PESTICIDES IN NURSING FUR SEAL PUPS.
Pestic. Monit. J. 8(4): 261 - 262.

Samples of muscle, brain, liver, blubber and ingested milk from nursing fur seal pups, (*Callorhinus ursinus*) were analyzed for organochlorine pesticides and polychlorinated biphenyls. DDT and its derivatives were the major chemicals mentioned, although dieldrin was found in nine of the samples.

6. Anderson, A. E. 1969.
2,4-D, SAGE BRUSH, AND MULE DEER-CATTLE USE OF UPPER WINTER RANGE.
Colo. Div. Game, Fish and Parks Spec. Rep. no. 21. 21 pp.

Eight distinct sage brush (*Artemisia tridentata*) communities, totalling 731 acres were aerially sprayed with 2,4-D to increase natural grass production for cattle. Sample counts of fecal groups and droppings showed a significant post-treatment decline in deer use of completely, partially, and intreated sagebrush habitats, and of the entire study area. Mule deer used oak (*Quercus gambelli*) dominated habitats significantly more than the three sagebrush and the coniferous-dominated habitats prior to and following treatment.

7. Anderson, D. W., and J. J. Hickey. 1972.
EGGSHELL CHANGES IN CERTAIN NORTH AMERICAN BIRDS.
Proc. Int. Ornithol. Congr. 15: 514 - 540.

Analysis of eggshell thickness-index changes on a decade-basis, carried out with 2088 eggs representing that many individual females of 11 species and 14 geographical areas, disclosed an apparent decrease in golden eagles in the 1890s in western North America; this represented 1 significant decade-change (a decrease) out of 91 decades compared. Comparisons in the other 13 analyses disclosed no significant changes. When this comparison was enlarged to include a total of 2,804 eggs through 1969, significant decade differences were apparent in 12 of the 14 cases, of these at the 0.005 level of probability. In this arbitrarily selected group of species, we conclude that eggshell changes were rare before 1939 and common sometime thereafter.

8. Anderson, D. W., J. J. Hickey, and R. W. Risebrough. 1969.
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS.
Can. Field Nat. 83(2): 91 - 112.

This paper reports levels of chlorinated hydrocarbons present in eggs, and spring food of double-crested cormorants (*Phalacrocorax auritus*) and white pelicans (*Pelecanus erythrorhynchos*) and the effects the residues might have upon the reproductive physiology of these species. There is good reason to belive that residues in the eggs provide a reliable index to fat-stored contamination in the female.

9. Anon. 1969.
THE TOXICITY OF SOME ORGANIC HERBICIDES TO CATTLE, SHEEP AND CHICKENS.
U. S. Dept. of Agric. Res. Serv. Production Research Report No. 106 - 22.

No abstract located.

10. Atkins, T. D., and R. L. Linder. 1967.
EFFECTS OF DIELDRIN ON REPRODUCTION OF PENNED HEN PHEASANTS.
J. Wildl. Mange, 31(4): 746-753.

Hen pheasants (*Phasianus colchicus*) were fed varied doses weekly. Some observations noted for low dosages were: hatchability was higher, food consumption, egg production, fertility of eggs, and weight gain were not affected by the treatments. However, high dosages significantly reduced food consumption, weight, and egg production.

11. Avrahami, M., and I. L. Gernert. 1972.
HEXACHLOROBENZENE ANTAGONISM TO DIELDRIN STORAGE IN ADIPOSE TISSUE OF FEMALE RATS.
New Zealand J. Agric. Res. 15(4): 783 - 787.

Three groups of rats were fed 1 ppm dieldrin, 1 ppm dieldrin plus hexachlorobenzene (HCB), and 1 ppm dieldrin plus 50 ppm HCB, respectively. Storage of dieldrin was depressed by HCB. Depression appeared directly related to the concentration of HCB in the diet, and there was no apparent threshold for initiation of the interactions. At the end of a ten-week period, adults had accumulated higher concentrations of HCB and lower concentrations of dieldrin than young rats.

12. Backstrom, J. 1969.
DISTRIBUTION STUDIES OF MERC URIC PESTICIDES IN QUAIL AND SOME FRESHWATER FISHES.
Acta Pharmacol. Toxicol. 27 (suppl 3): 1 - 103.

A study done with mercury and its effects on quail. Results stated that the methyl mercury radical was found to be very stable in the avian body whereas phenyl mercury was rapidly decomposed to inorganic mercury. Methyl mercury was characterized by an even distribution of mercury in most organs including the kidneys, and by a slow excretion. After injection of methyl mercury, the brain slowly reached a high concentration of mercury. Injection of the other mercurials only resulted in a small cerebral uptake of mercury.

13. Barber, T. A., and J. G. Nagy. 1971.
EFFECTS OF PESTICIDES ON MULE DEER RUMEN BACTERIA.
Trans. N. Am. Wildl. Nat. Resour. Conf. 36: 153 - 162.

Tests were carried out on pure strains of rumen bacteria *in vitro*. Results indicate inhibitory levels exceed acute toxic doses for deer but conclusions as to effect of pesticides *in vivo* on rumen function were not formulated. A single dose of pesticide probably has little effect; chronic exposure would allow for alterations in rumen microflora.

14. Barrett, G. W. 1968.
THE EFFECTS ON AN ACUTE INSECTICIDE STRESS ON A SEMI-ENCLOSED GRASSLAND ECOSYSTEM.
Ecology 49 (6): 1019 - 1039.

The effect of a carbamate insecticide, sevin, on plant, arthropod and mammal components within a grain crop grassland ecosystem were investigated. Although the insecticide remained toxic in the environment for only a few days, long-term side effects on litter decomposition, arthropod density and diversity, and mammaliam reproduction were demonstrated.

15. Barrett, G. W., and R. M. Darnell. 1967.
EFFECTS OF DIMETHOATE ON SMALL MAMMAL POPULATIONS.
Amer. Midland Natur. 77(1): 164 - 175.

The effect on populations of the prairie vole (*Microtus ochrogaster*), the house mouse (*Mus musculus*), and the prairie deer mouse (*Peromyscus maniculatus*), were investigated by means of live trapping grids in an Indian clover field. House mice decreased in numbers after spraying while prairie voles increased and deer mice remained at the same density.

16. Baskett, T. S. 1975.
MERCURY RESIDUES IN BREAST MUSCLES OF WILD DUCKS, 1970 - 1971.
Pestic. Monit. J. 9 (2): 67 - 78.

In samples of breast muscles from 327 ducks mercury ranged from 0.01 to 3.91 ppm wet weight with a median of 0.10 ppm. Twenty-five ducks had levels equalling or exceeding the 0.5 ppm guideline for fish and shellfish established by the Food and Drug Administration, U. S. Department of Health, Education and Welfare. Dabbling ducks usually had lower levels than diving ducks and sea ducks. Despite the mobility of the ducks, lvels seemed more closely linked to local environmental contamination than to various factors associated with large geographic areas.

17. Baxter, W. L., L. Linder, and R. B. Dahlgren. 1969.
DIELDRIN EFFECTS IN TWO GENERATIONS OF PENNED HEN PHEASANTS.

Effects of encapsulated dieldrin fed to penned hen pheasants (*Phasianus colchicus*) were studied through two generations, and were evaluated by measuring food consumption, weight and egg production of hens, fertility and hatchability of eggs, survival, weight gain and behaviour of chicks. No mortality occurred in first-generation hens but among second generation hens there was mortality in all groups receiving dieldrin.

18. Beardmore, C. J., and R. J. Robel. 1976.
WEIGHT AND BODY FAT RECOVERY BY DIELDRIN-DOSED UNDERWEIGHT BOBWHITES.
J. Wildl. Manage. 40 (1): 118 - 121.

Adult male bobwhites (*Colinus virginianus*) were starved to 80 percent of their normal body weight then given unlimited food and 50, 100 or 150 mg of dieldrin every other day for 10 days. Dieldrin did not alter recovery of either body weight or ether-extractable fat reserves by underweight bobwhites.

19. Bedford, C.T., D. H. Hutson, and L. L. Natoff. 1976.
THE ACUTE TOXICITY OF ENDRIN AND ITS METABOLITES TO RATS.
Toxicol. Appl. Pharmacol. 33 (1): 115 - 121.

The acute oral LD_{50} values based on 10-d mortalities for endrin and its metabolites were measured in rats. The metabolites were all more toxic than the parent insecticide.

20. Belisle, A. A., W. L. Reichel, L. N. Locke, T. G. Lamont, B. M. Mulhern,
R. M. Prouty, R. B. DeWolfe, and E. Cromartie. 1972.
RESIDUES OF ORGANOCHLORINE PESTICIDES, POLYCHLORINATED BIPHENYLS, AND MERCURY AND AUTOPSY DATA FOR BALD EAGLES, 1969 and 1970.
Pestic. Monit. J. 6(3): 133 - 135.

Thirty-nine bald eagles found sick or dead in 13 states during 1969 and 1970 were analyzed for pesticide residues. Residues of DDE, dieldrin, polychlorinated biphenyls (PCBs) and mercury were detected in all bald eagle carcasses; DDD residues were detected in 38; DDT, heptachlor epoxide, and dichlorobenzophenone (DCBP) were detected less frequently. Six eagles contained possible lethal levels of dieldrin in the brain, and one contained a lethal concentration of DDE (385 ppm) in the brain together with 235 ppm of PCBs. Autopsy revealed that 18 bald eagles were illegally shot; other causes of death were impact injuries, electrocution, emaciation and infectious diseases.

21. Benson, W. W., and J. Gabica. 1970.
INSECTICIDE RESIDUES IN STARLINGS IN IDAHO.
Bull. Environ. Contam. Toxicol. 5: 243 - 246.

Forty-seven starlings were live trapped in the area of a cattle feed lot. Birds were taken to the laboratory where they were killed. The starlings' fat samples were high in organochlorine insecticides.

22. Benson, W. W., J. Gabica, and J. Beecham.
PESTICIDE AND MERCURY LEVELS IN BEAR.
Bull. Environ. Contam. Toxicol. 11 (1): 1 - 4.

Pesticide and mercury levels in *Ursus americanus* tissue collected during the October - November, 1972 hunting season in Idaho were investigated. Analysis for pesticides was made on body fat for six bears and on muscle tissue for two others. The analysis was by ^3H foil electron capture gas chromatography. The average residue levels for pesticides and mercury were well below the maximum tolerance allowed by the FDA for domestic livestock.

23. Benson, W. W., M. Watson, and J. Wyllie.
ORGANOCHLORINE RESIDUES IN WILD MOOSE, IDAHO, 1972.
Pestic Monit. J. 7 (2): 97 - 99

In 1972, samples of adipose tissue from 14 moose (*Alces alces shirasi*) from the Targhee National Forest in eastern Idaho were analyzed by gas liquid chromatography for organochlorine residues. Residues detected and respective mean levels for each were: p.p. - DDT, 52.3 ppb; p.p - DDE, 28.9 ppb: p.p - DDD, 53.0 ppb: a-BHC, 77.5 ppb: and dieldrin, 5.0 ppb. The presence of significant BHC levels in these animals probably reflects the prior use of BHC within the forest for control of pine bark beetle infestation.

24. Benson, W. W., D. W. Brock, J. Gabica, and M. Loomis.
PESTICIDE AND MERCURY LEVELS IN PELICANS IN IDAHO.
Bull. Environ. Contam. Toxicol. 15 (5): 543 - 546.

Twelve white pelicans (*Pelicanus erythrorhynchos*) collected in Southern Idaho during early summer of 1974 were analyzed for tissue mercury levels using gas chromatography. The liver tissues contained the highest mercury levels. An additional bird, found dead was examined for organochlorine residues.

25. Best, L. B. 1972.
FIRST YEAR EFFECTS OF SAGEBRUSH CONTROL ON TWO SPARROWS.
J. Wildl. Manage. 36 (2): 534 - 544.

To examine the effects of sagebrush (*Artemisia tridentata*) control on two nongame birds: Brewer's sparrows (*Spizella breweri*) and vesper sparrows (*Pooecetes grameneus*), plots were established in sagebrush grassland habitat and subjected to five treatments. Only on the total kill spray plot did breeding pairs of Brewer's sparrows notably decline after spraying. No significant changes occurred in pairs of vesper sparrows in the sprayed plots.

26. Bitman, J., H. C. Cecil, and S. J. Harris. 1974
EFFECTS OF NONPERSISTENT PESTICIDES ON LIVER WEIGHT, LIPIDS AND VITAMIN A OF RATS AND QUAIL.
Bull. Environ, Contam. Toxicol. 11 (6): 496 - 499 .

The report compares the effects of three nonpersistent pesticides (the organochlorine methoxychlor, the carbamate carbaryl, and an organophosphate malathion) on liver weight, lipid, and Vitamin A in the laboratory rat (*Rattus norvegicus*) and Japanese quail (*Coturnix japonica*).

27. Bogan J. A. 1973.
CONTINUING DANGERS TO PEREGRINES FROM DIELDRIN.
British Birds. 66: 437 - 439.

No abstract located.

28. Bohmont, B. L. 1967.
TOXICITY OF HERBICIDES TO LIVESTOCK, FISH, HONEY BEES AND WILDLIFE.
West Weed Contr. Conf. Proc. 21: 25 - 27

No abstract located.

29. Borg, K. 1968.
THE LAND FAUNA AND THE MERCURY CONTAINING PESTICIDES AND WEED KILLERS.
Fauna Flora 63(5): 186 - 189.

The only abstract located said nothing more than that mercury was found in seed eating birds, and in higher concentrations in birds of prey.

30. Borg, K., K. Erne, E. Hanko, and H. Wanntrop. 1970.
EXPERIMENTAL SECONDARY METHYL MERCURY POISONING IN THE GOSHAWK (*ACCIPTER G. GENTILIS L.*)
Environ. Pollut. 9(2): 91 - 104.

Chickens were fed methyl mercury dressed wheat for five - six weeks and were sacrificed. Muscle and some liver of the chickens were fed to goshawks. Goshawks died at different periods depending upon dosage. Other histological changes were also studied. The ecological implications are discussed.

31. Borg, K., H. Wanntrop, K. Erne, and E. Hanko. 1969.
ALKYL MERCURY POISONING IN TERRESTRIAL SWEDISH WILDLIFE.
Viltrevy 6(4): 301 - 379.

Of 253 seed-eating birds found dead, 48 percent had mercury levels of above 2 mg/kg. Of 412 predatory birds, some of which were found dead, others shot or trapped, 62 percent had liver values exceeding 2 mg/kg. Mercury poisoning was demonstrated in some mammalian predators as well.

32. Broughton, E. 1969.
LABORATORY REPORT ON THE EXAMINATION OF BLUE GEESE FROM ROUND LAKE MAN.
C. W. S. Pathology Section, Ottawa, Ont. 3pp. Unpublished.

On October 1, 1969 dead blue geese were found on Round Lake, Manitoba. Four samples were taken to the laboratory and examined. Organic mercury was found to be the cause of death.

33. Brown J. R. 1973
SOME CONSIDERATIONS OF PESTICIDES AS ENVIRONMENTAL CONTAMINANTS.
University of Toronto Inst. Environ. Sci and Eng. 18 pp.

A general paper explaining the good and the bad effects of pesticide usage. DDT is the most commonly mentioned pesticide. The paper also refers to many other pesticides, what they are used for and how they should be used, but reports no experimental findings.

34. Buckner, C. H. 1974.
THE BIOLOGICAL SIDE EFFECTS OF FENITROTHION IN FOREST ECOSYSTEMS.
Environment Canada Chem. Control Res. Inst. Ottawa Rep. CC-X-67.

No abstract located.

35. Buckner, C. H., and D. Ray. 1973.
SONGBIRD POPULATIONS IN THE SPRUCE BUDWORM MOTH CONTROL AREA, N.W. NEW BRUNSWICK PRIOR TO TREATMENT WITH PHOSPHAMIDON.
Can. For. Ser.

No abstract for this paper could be located.

36. Buckner, C. H., B. B. McLeod, and D. G. H. Ray. 1973.
THE EFFECTS OF OPERATIONAL APPLICATION OF VARIOUS INSECTICIDES ON SMALL FOREST BIRDS AND MAMMALS.
Chemical Control Research Inst. Info. CC-X-43.

Studies carried out in Ontario, New Brunswick and Quebec in conjunciton with spraying of the spruce budworm. Matacil had little or no detrimental effect on small mammal populations in New Brunswick. In Ontario, fenitrothion, at the rate of 18 ounces per acre reduced populations of ruby and golden crowned kinglets and yellow-bellied flycatchers. Turdis and Picids seemed unaffected. No results for Quebec operations or for zectran usage were presented.

37. Buckner, C. H., D. G. H. Ray, and B. B. McLeod. 1973
THE EFFECTS OF PESTICIDES ON SMALL FOREST VERTEBRATES OF THE SPRUCE WOODS PROVINCIAL FOREST, MANITOBA.
Manitoba Entomologist 7: 37 - 45

The Spruce Woods Provincial Forest, Manitoba was sprayed in June, 1973 for control of the spruce budworm *Choristoneura fumiferana* (Clemens). Populations of songbirds and small mammals were monitored on seven 20-acre study plots to determine effects of the applied insecticides on animals other than the target insect. Two of the study plots were on fenitrothion spray blocks, two on dipel spray blocks, one on a block sprayed with sevin-4-oil and two outside the spray zone as controls. Bird populations were assessed before and after the insecticide applications by the singing male census technique, and small mammals were kill-trapped about 2 months after the spray to compare breeding conditions of sprayed populations with those on the controls. The observational data and analyses of variance showed no changes that could be attributed to the treatment.

38. Budreau, C. H., and R. P. Singh. 1973.
EFFECT OF FENTHION AND DIMENTHOATE ON REPRODUCTION IN THE MOUSE.
Toxicol. Appl. Pharmacol. 26(1): 29 - 38.

Five generations of CD-1 mice were maintained on a diet containing 60 ppm fenthion or dimethoate in drinking water. Dimethoate treatment altered reproductive performance as indicated by reduced mating success and longer reproduction time. Fenthion showed an increase in pup mortality.

39. Bunch, J. D. 1973.
EFFECT OF DIELDRIN ON CHROMOSOMES OF BONE MARROW AND LYMPHOCYTES OF THE SEMI-DOMESTIC MALLARD DUCK.
Diss. Abstracts Int. 33(7): 3381 B.

Juvenile mallard ducks from parents receiving long-term doses of dieldrin were maintained on similar levels of 0, 4, 10 and 30 ppm for approximately 60 days. In ducks exposed to 30 ppm dieldrin the mitotic index was reduced more than five times. (significant difference $P=0.05$).

40. Bunyan, P. J., D. M. Jennings, and A. Taylor. 1969.
ORGANOPHOSPHORUS POISONING. CHRONIC FEEDING OF SOME PESTICIDES TO PHEASANTS *PHASIANUS COLCHICUS* AND PIGEONS *COLUMBA LIVIA*.
J. Agric. Food Chem. 17(5): 1027 - 1032.

This work was undertaken to obtain a reliable method of diagnosing fatal poisoning in wild birds following the agricultural use of these compounds. Pheasants and pigeons were fed for varying periods with food dressed with 100 ppm of demeton-methyl, diazinon, dimethoate or phorate. Pesticide residue analysis of liver, fat, and breast muscle was undertaken. The differing toxicities of the four pesticides and the relative susceptibility of the two species to pesticides intoxication are discussed.

41. Burrage, R. H., and J. G. Saha. 1972.
INSECTICIDE RESIDUES IN PHEASANTS AFTER BEING FED ON WHEAT SEED TREATED WITH HEPTACHLOR AND 14C-LINDANE.
J. Econ. Entomol. 65(4): 1013 - 1017.

Different amounts of heptachlor treated wheat seed containing 365 ppm heptachlor and 105 ppm trans-chlordane were fed to pheasants for different lengths of time, and residues in muscles, liver, brain, and fatty tissues were determined at various times later. It was concluded that lindane seed dressings are probably less hazardous to seed eating birds than heptachlor seed dressings.

42. Cade, T. J., C. M. White, and J. R. Haugh. 1968.
PEREGRINES AND PESTICIDES IN ALASKA.
Condor 70 (2): 170 - 178.

All tissues of peregrine falcons *Falco peregrinus* contained measurable amounts of DDE, TDE, and DDT and most tissues also contained dieldrin. Whole eggs and chicks contained about 15 ppm of total residues including dieldrin. Residues in peregrines eggs and chicks were 10 - 100 times more concentrated than in prey species.

43. Cagan, R. H., M. R. Kare, and J. G. Rogers. 1974.
PERCUTANEOUS ABSORPTION OF SEVERAL CHEMICALS, SOME PESTICIDES INCLUDED, IN THE RED-WINGED BLACKBIRD.
Environ. Physiol. and Biochem. 4(3): 104 - 111.

Percutaneous absorption in vivo through the skin of the feet of the red-winged blackbird *Agelaius phoeniceus* has been investigated. Of all solutions tested, only DDT and diethylstilbesterol were not absorbed to a measureable degree. However, it appeared unlikely that percutaneous absorption contributes greatly to the body burden of *A. phoeniceus*.

44. Call, D. J., and B. E. Harrell. 1974.
EFFECTS OF DIELDRIN AND PCB's UPON THE PRODUCTION AND MORPHOLOGY OF JAPANESE QUAIL EGGS.
Bull. Environ. Contam. Toxicol. 11(1): 70 - 77.

A study done with Japanese quail on the effect of dieldrin and PCB's on egg shell thinning. Significant egg shell thinning occurred with all dieldrin and PCB treatments.

45. Carr. H. D. 1968.
A LITERATURE REVIEW ON EFFECTS OF HERBICIDES ON SAGE GROUSE.
Colo. Div. Game Fish Parks Spec. Rep. No. 13.

This study investigated the effect of 2,4-D on density of sage brush and forbs. Spraying of 2,4-D resulted in habitat unsuitable for sage grouse.

46. Charnetski, W.A., and W. E. Stevens. 1974.
ORGANOCHLORINE INSECTICIDE RESIDUES IN PREEN GLANDS OF DUCKS: POSSIBILITY OF RESIDUE EXCRETION.
Bull. Environ. Contam. Toxicol. 12(6): 672 - 676.

Pesticide loads in 21 ducklings (seven gadwalls, eight pintails, two blue-winged teal, one lesser scaup and three baldpates) were obtained at the natal site or through contaminant transfer to the egg. Insecticide levels were analysed by gas chromatography. The insecticides located were dieldrin, DDT and DDE.

47. Clark, D. R., Jr. 1975
EFFECT OF STRESS ON DIELDRIN TOXICITY TO MALE RED-WINGED BLACKBIRDS.
Bull. Environ. Contam. Toxicol. 14(2): 250 - 256.

Stressed red-winged blackbirds died in a shorter time and had higher brain levels of dieldrin than did unstressed blackbirds.

48. Clark, D. R., Jr., and M. A. R. McLane. 1974.
CHLORINATED HYDROCARBON AND MERCURY RESIDUES IN WOODCOCK IN THE UNITED STATES, 1970 - 1971.
Pestic Monit. J. 8(1): 15 - 22.

Analysis for chlorinated hydrocarbons and Hg in 229 woodcock (*Philohela minor*) showed generally low levels which are not considered dangerous to human consumers. Louisiana woodcock had lower residues of heptachlor epoxide and DDE than those tested in a 1965 survey. Polychlorinated biphenyl (PCB) levels may have increased. Mirex levels were greatest in the Mississippi and Louisianna woodcock. The pooling of birds and averaging of individually analyzed birds did not provide equivalent estimates of equivalent residues; pool values tended to be larger and more variable. Levels of six chlorinated hydrocarbons and Hg were negatively correlated with the latitude of the collection site. This relationship seemded weakest for PCB's. Among eight chemical residues, PCB levels were most often correlated with levels of the other seven. Levels of chlorinated hydrocarbons in wings were correlated with levels in breast muscle and in carcass. Mean levels of certain residues differed significantly among wing, muscle and carcass even when compared on a lipid basis.

49. Coleman, R. L., C. H. Lawrence, and W. L. Sowell. 1968.
TRACE METAL ALTERATIONS FOLLOWING SUBACUTE EXPOSURE TO ENDRIN.
Bull. Environ. Contam. Toxicol. 3(5): 284 - 295.

Sub-acute oral exposure of rats to multiple doses of endrin totalling 8 mg per kg of body weight, produce, over an eight-day period, the following observations: (a) Of the organs studied only the spleen demonstrated meaningful changes in the organ size parameters observed and these were manifested as decreases. By comparison, the results of the acute study reported earlier indicate the spleen to be the only organ studied that did not experience a significant change in size. (b) From the standpoint of trace metal translocation, the number of shifts observed after eight days of sub-lethal exposure was small compared to those known to occur during the initial intoxication, thus indicating a tendency on the part of most organs to recover. The notable exceptions included an increase in both the total as well as the concentration of magnesium in the liver and an increase in not only the total but also the concentration of copper in kidney.

50. Collins, T. F. X., 1972.
DOMINANT LETHAL ASSAY: I. CAPTAN.
Food Cosmet. Toxicol. 10(3): 353 - 361.

Five daily doses of the fungicide captan were given to male rats and mice, which were then mated to untreated females for 10 and 12 weeks, respectively. Captan produced negligible antifertility effects and a minimal reduction in the mean number of total implants per pregnancy. Increases in the mean number of early fetal deaths per pregnancy and a measure of mutagenic effect were seen in both species after i.p. and oral administration. Significant linear trends were observed for the numbers of litters with two or more early deaths in both rats and mice.

51. Cooke, A.S. 1972
THE EFFECTS OF DDT, DIELDRIN AND 2,4-D ON AMPHIBIAN SPAWN AND TADPOLES.
Environ. Pollut. 3(1): 51-68.

Effects of DDT, dieldrin and 2,4-D on the spawn or tadpoles of the common frog, common toad or smooth newt are described. Dieldrin caused lower mortality among tadpoles than DDT and had less effect on behaviour, although, like DDT it produced distinct behavioural changes and morphological abnormalities. Only frog tadpoles were treated with 2,4-D. It had no visible effect and no tissue residues could be detected even after treatment in 50 ppm for 48 hours.

52. Cope, O.B. 1971.
INTERACTIONS BETWEEN PESTICIDES AND WILDLIFE.
Annu. Rev. Entomol. 16: 325-364.

The paper presents a discussion of acute toxicity, residues, effects on physiology, and effects through the environment. No specific pesticides were mentioned in the abstract. 172 references.

53. Cramp, S. 1973.
THE EFFECTS OF PESTICIDES ON BRITISH BIRDS.
Br. Vet. J. 129(4): 315-323.

A general non-technical paper on the effects of pesticides on British birds. Organochlorines were the most discussed group of pesticides. Twenty species of birds which occur in Manitoba are mentioned in the paper.

54. Cromartie, E., W. L. Reichel, L. N. Locke, A. A. Belisle, T. E. Kaiser, T. G. Lamart, B. M. Mulhern, R. M. Prouty, and D. M. Swineford. 1976.
RESIDUES OF ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS AND AUTOPSY DATA FOR BALD EAGLES, 1971 - 1972.
Pestic. Monit. J. 9(1): 11-14.

Thirty-seven bald eagles, which were found dead or sick in 18 states were examined for organochlorine, pesticides and polychlorinated biphenyls. Thirty carcasses contained DDE, 28 contained dieldrin, and all carcasses contained DDD.

55. Culley, D. D., and G. Applegate. 1967.
PESTICIDES AT PRESIDIO: IV. REPTILES, BIRDS AND MAMMALS.
Tex. J. Sci. 19(3): 301-310.

Data are presented on pesticide concentrations in various animals of the Presidio area. Birds had the highest concentrations in muscle tissues with reptiles and mammals having less but similar concentrations.

56. Dahlgren, R. B., and R. L. Linder. 1970.
EGGSHELL THICHNESS IN PHEASANTS GIVEN DIELDRIN.
J. Wildl. Manage. 34(1): 226-228.

For 16 weeks, penned breeding hen pheasants (*Phasianus colchicus*) were given one capsule per week containing either lactose or lactose and 4, 6, or 10 mg technical grade dieldrin. Under the conditions of this experiment, no significant differences ($P>0.05$) in eggshell thickness were found between any of the control and dieldrin groups.

57. Dahlgren, R. B., and R. L. Linder. 1974.
EFFECTS OF DIELDRIN IN PENNED PHEASANTS THROUGH THE THIRD GENERATION.
J. Wildl. Manage. 38(2): 320-330.

In 1968 and 1969, single capsules containing lactose and lactose and dieldrin were given weekly to pheasants (*Phasianus colchicus*). Effects of the dieldrin were studied throughout the second and third generations. Behavioral patterns and survival of offspring were affected in these subsequent generations also.

58. Dahlgren, R. B., R. L. Linder, and K. K. Ortman. 1970.
DIELDRIN EFFECTS ON SUCEPTIBILITY OF PENNED PHEASANTS TO HAND CAPTURE.
J. Wildl. Manage. 34(4): 957-959.

The offspring of pheasants (*Phasianus colchicus*) which were given 16 capsules once a week of lactose or combinations of lactose and 4, 6, and 10 mg technical grade dieldrin were placed in outdoor pens when five weeks of age. In July, August, October, December and January, these young pheasants were caught by hand. They were most easily caught if both parents had received dieldrin, followed in order by those where hens only and cocks only had received dieldrin.

59. D'Arca, S. U., V. Leoni, and E. D'Allessandro de Luca. 1973.
BIRD MORTALITIES CAUSED BY AGRICULTURAL USE OF PESTICIDES (In Italian, English Summary).
Nudovi Annali D'Igiene e Microbiologia 24(3): 149-155.

This note presents the results of a research performed in connection with the occurrence of two severe mortalities of birds (1971 and 1973) in the vicinity of Rome.

It has been verified that the main cause of the aforementioned mortalities was in both cases the parathion, which has been found in the soil, in the water and in the carcasses of the birds. In one of the cases, large quantities of hexachlorobenzene (HCB) have also been found, in the stomach and the liver of the birds.

The note points out that in particular environmental conditions some of the organophosphorus pesticides and among these the parathion could have a higher persistence that it is usually believed.

60. Davison, K. L. 1973.
DIELDRIN - C - 14 BALANCE IN RATS, SHEEP AND CHICKENS.
Bull. Environ. Contam. Toxicol. 19(1): 16-24.

Experiments were conducted with rats, sheep and chickens to determine whether or not excretion of carbon-14 from dieldrin-14C would balance ingestion or dieldrin-14C when ingestion remained constant. The data suggest that rats of either sex attained balance by 22 or 26 weeks, depending on the amount of dieldrin fed; and that hens apparently attained balance by 25 weeks regardless of the amount of dieldrin fed.

61. Davison, K. L., and J. L. Sell. 1974.
DDT THINS SHELLS FROM MALLARD DUCKS MAINTAINED ON *AD LIBITUM* OR CONTROLLED - FEEDING REGIMES.
Arch. Environ. Contam. Toxicol. 2(3): 222 - 232.

Mallard ducks were fed either DDT or dieldrin. Significant reductions in eggshell thickness, eggshell weight, and calcium were noted. Neither DDT nor dieldrin affected weight of the eggs or rate of egg production.

62. Dieter, M.P., and J. L. Ludke. 1975
COMBINED EFFECTS OF ORGANOPHOSPHATES AND HEAVY METALS IN BIRDS. PLASMA AND BRAIN CHOLINESTERASE IN COTURNIX QUAIL FED METHYLMERCURY AND ORALLY DOSED WITH PARATHION.
Bull. Environ. Contam. Toxicol. 13(3): 257 - 262.

Mercury potentiated the toxicity and biochemical effects of parathion.

63. Dubois, K. P. 1971.
THE TOXICITY OF ORGANOPHOSPHOROUS COMPOUNDS TO MAMMALS.
Bull. W.H.O. 44(1-2-3): 233 - 240.

The effect of malathion and other organophosphorous insecticides were studied. Young animals are more susceptible to the organophosphorous compounds than the adults. Enzyme inducing agents decrease the toxicity of the phosphorothioates. All organophosphorous insecticides can inhibit esterases that catalyse the detoxification of some insecticides of this class, and ester type drugs.

64. Dunachie, J. F., and W. W. Fletcher. 1969.
AN INVESTIGATION OF THE TOXICITY OF INSECTICIDES TO BIRDS' EGGS USING THE EGG INJECTION TECHNIQUE.
Ann. Appl. Biol. 64(3): 409 - 423.

Twenty-five insecticides were tested for their toxicity to hen embryos at various concentrations, using an egg-injection technique. Of the two major groups, the organophosphorus compounds are much more toxic than the organochlorine. Most organophosphorus compounds lower the hatch rate and cause teratogenic effects at 100 ppm. Most organochlorines do not harm the embryo at high dosages (up to 500 ppm), with notable exceptions to this among the cyclodienes.

However, starvation of the hatched chicks suggests that the majority of organochlorine compounds can kill at this stage, though fed chicks survive. The solvent used affected toxicity; in general, insecticides are more toxic to the embryo when dissolved in corn oil than when dissolved in acetone. If these findings can be applied to wild birds, it can be assumed that the vast majority of insecticides are harmless to birds' eggs. They are either not toxic in the concentrations so far found in this country, or else unlikely to pass through the mother bird to the egg.

65. Dunbar, M. J. 1969.
RAPE OF THE ENVIRONMENT: STATEMENT OF ENVIRONMENTAL POLLUTION AND DESTRUCTION IN CANADA.
Survey report, Water Sector Library. McGill Univ. 30 pp.
Library access number TD 180 C3.

66. Dustman, E. H., L. F. Stickel, and J. B. Elder. 1972.
MERCURY IN WILD ANIMALS, LAKE ST. CLAIR.
Pages 46 - 52 in R. Hartung and B. D. Dinnan, Eds. Environ. Mercury Contamination.
Ann Arbor Science Publisheres, Inc. Ann Arbor, Mich.

A study at Lake St. Clair to determine mercury concentrations in animals. Mercury levels of two fish eaters, great blue heron and common tern, far exceeded those in any other species. Mercury concentrations were also found in waterfowl, birds eggs, fish, frogs, and pheasants.

67. Edwards, C. A. 1973.
PERSISTENT PESTICIDES IN THE ENVIRONMENT.
2nd ed. C.R.C. Press, Cleveland, Ohio. 177 pp.

Government control of pesticide use is discussed and the dynamics of pesticides in the environment is presented. Comparative data on the amounts of residues in the environment are presented, showing where the largest residues are and how they are concentrated from the physical environment into plants and animals, from lower organisms into the higher trophic levels of food chains.

68. Ehrich, M., R. Ouellette, and S. D. Cohen. 1976.
TOXICOLOGIC INTERACTIONS INVOLVING DICHLORVOS (DDVP).
Society of Toxicology. Academic Press, London, England. 27 pp.

Male mice were given dieldrin and sacrificed four days later. Tests were conducted *in vivo* with DDVP. The paper outlines some of the metabolic pathways and functions of the chemical.

69. Elliott, M., N. F. Janes, E. C. Kimmel, and J. E. Casida. 1972.
METABOLIC FATE OF PYRETHRIN I, PYRETHRIN II AND ALLETHRIN ADMINISTERED ORALLY TO RATS.
J. Agric. Food Chem. 20(2) 300-313.

Pyrethrin I, pyrethrin II and allethrin were administered orally to rats and the metabolites excreted in the urine were isolated by column chromatography and characterized by derivatives (particularly by nuclear magnetic resonance and mass spectroscopy.) Rapid detoxification in mammals is probably an important factor in the selective toxicity of pyrethroids.

70. Enderson, J. H., and D. D. Berger. 1968.
CHLORINATED HYDROCARBON RESIDUES IN PEREGRINES AND THEIR PREY SPECIES FROM NORTHERN CANADA.
Condor 70 (2): 149 - 153.

Peregrine falcon (*Falco peregrinus*) adipose tissue, egg and prey species were analyzed for organochlorine residue by electron capture gas chromatography. Residues of DDT, its metabolites, dieldrin, and heptachlor epoxide were found in most specimens. All data suggest that adult peregrines in northern Canada carry high levels of organochlorine residues acquired over a period of many months. Their eggs bear about twice the levels found in eggs from the stricken British peregrine population; even with these precariously high levels, the Canadian peregrines appear to be reproducing normally.

71. Enderson, J. H., and D. D. Berger. 1970.
PESTICIDES: EGG SHELL THINNING AND LOWERED PRODUCTION OF YOUNG IN PRAIRIE FALCONS (*FALCO MEXICANUS*).
Bioscience 20(6): 355 - 356.

The data establish a correlation between pesticide residues, thin eggshells, and poor hatching success.

72. Englert, H. K. 1975.
RESIDUE ANALYSES OF CHLORINATED HYDROCARBON IN DECEASED WILD ANIMALS AND HEALTHY HUNTED NATIVE WILD ANIMALS.
Umweltschutz 28 (11, suppl.): 367 - 369 [In German, English summary].

Results of systematic organochlorine pesticide residue analyses in deceased and healthy hunted game in West Germany are presented. Roes and hares contained lindane, heptachlor, haptachlor epoxide, p,p' - DDE, aldrin, and dieldrin residues usually well below the maximum allowable concentrations. Hexachlorobenzene residues were above the acceptable limit in an increasing number of cases. The pesticide residues were about 10 times higher, but still below toxic concentrations in carnivorous species, such as foxes and martens.

73. Epstein, S. S. 1976.
THE CARCINOGENICITY OD DIELDRIN. PT. II.
Sci. Total Environ. 4(3): 205 - 217.

A study done with infant mice which were exposed to dieldrin for limited periods. It was found that liver cancer was developed later in life, and that the incidence of tumors is dependent on the period of early exposure.

74. Erne, K. 1974.
HERBICIDES AND WILD ANIMALS - SEVERAL RECENT FINDINGS: STARTING POINT OF THE INVESTIGATIONS - REINDEER DEATHS IN LAPLAND.
Z. Jagdwiss. 20(1): 68 - 70. [In German, German and English summaries].

In leafy vegetation sprayed at the normal rate with phenoxy-herbicides relatively high residue levels were found. The residues under certain circumstances were persistent. The residue levels found in wild berries and mushrooms from sprayed areas were moderately high.

In wildlife found dead or shot in herbicide treated woodland areas, phenoxy-herbicide residues were found occasionally. The tissue levels were below 6 ppm, most of the values below 1 ppm, and thus very low compared to those observed in experimentally poisoned animals. Toxicity experiments indicated the acute and chronic toxicities of 2,4-D and 2, 4, 5-T in reindeer to be comparable to those observed in laboratory and domestic animals.

75. Faber, R. A. and J. Hickey. 1973.
EGGSHELL THINNING, CHLORINATED HYDROCARBONS, AND MERCURY IN INLAND AQUATIC BIRD EGGS, 1969 AND 1970.
Pestic, Monit. J. 7(1): 27 - 36.

Study carried out in many of the states of the U.S. on various species of birds, and for many different chemicals. Chemical levels varied with the species and with the location. Some good data on pesticide percentages are presented in the body of the report.

76. Faber, R. A., R. W. Risebrough, and H. M. Pratt. 1972.
ORGANOCHLORINES AND MERCURY IN COMMON EGRETS AND GREAT BLUE HERONS.
Environ. Pollut. 3(2): 111 - 122.

Mean thickness of all egret and heron eggshells recovered from the floor of the heronry were 15.2 and 10.4 percent lower, respectively, than pre-1947 values. Eggs of both species, broken during incubation, were seventeen percent below normal thickness. Concentrations of DDE recorded in egg lipids and in the carcasses of adults found dead or moribund were comparable with those found in other species now producing thinshelled eggs. Poly-chlorinated biphenyls ranged up to 15 ppm in the brain and 93 ppm in the livers of adult egrets, and concentrations of total mercury in the liver ranged between 2 and 9.5 ppm. Dieldrin concentrations in the brains of four adult egrets found dead or moribund ranged between 5 and 7 ppm, suggesting death by dieldrin poisoning. Ratios of DDE and PCB in the more heavily contaminated egrets indicated that the birds had acquired the major part of their body residues on the wintering ground rather than in the immeidate vicinity of the colony.

77. Fay, L. D., and W. G. Youatt. 1967.
RESIDUES OF CHLORINATED HYDROCARBON INSECTICIDES IN LOONS, GREBES, A GULL, AND A SAMPLE OF ALEWIVES FROM LAKE MICHIGAN.
Mich. Dept. Conserv., Res. Dev. Rep. 109. 7 pp. Mimeogr.

DDT residues were found in the breast muscle and brain of loons, grebes a ring-billed gull, and a sample of alewives from Lake Michigan. Aldrin occurred rather frequently, heptachlor infrequently in breast muscle from loons. Methoxychlor was found in the brain of one loon. Endrin in addition to DDT residues occurred in the single alewife sample analyzed. Chlorinated hydrocarbon insecticide levels were low in the tissue samples and these materials appear not to be the direct cause of death of the birds. While insidious physiologic effects might be ascribed to low tissue levels of pesticides, it would hardly appear that this was an important factor in the bird die-offs in Lake Michigan. Field and laboratory studies indicated the birds died quickly from an acute illness.

78. Feland, B., and J. T. Smith. 1972.
MELATHION INTOXICATION AND MITOCHONDRIAL DAMAGE.
J. Agric. Food. Chem. 20(6): 1274 - 1275.

Malthion-fed rats exhibited a decrease in hexosamine content of intact liver mitochondria; no such decrease was observed in nuclei. Decreased hexosamine content coupled with decreased sulfate uptake indicated loss of mucopolysaccharide from mitochondria. Extraction procedures indicated that in addition to mucopolysaccharide loss, a loss in N from mitochondrial membrance also occurred. A decrease in swelling confirmed the apparent loss in mitochondrial integrity following malathion feeding.

79. Fimreite, N. 1971.
EFFECTS OF DIETARY METHYLMERCURY ON RING-NECKED PHEASANTS WITH SPECIAL REFERENCE TO REPRODUCTION.
Can. Wildl. Serv. Occas. Pap. 9: 39 pp.

The effects of methyl-mercury-treated grain (methylmercury dicuandiamide) on penned pheasants (*Phasianus colchicus*) were studied in a two-way factorial experiment, the factors involved being mercury levels (100, 50 and 25 percent treated in the grain ration) and the length of the experimental feeding period (two, four and 12 weeks). Three additional groups served as controls. Strong adverse effects on reproduction were found: the most important indication was reduced hatchability, followed by reduced egg production and a large number of shell-less eggs. Chick survival was comparatively less affected. Egg weight was reduced significantly in most of the experimental groups, especially during the last weeks of the experiment, and the highest mercury levels produced a large number of eggs with abnormal color.

80. Fimreite, N., and L. Karstad. 1971
EFFECTS OF DIETARY METHYL MERCURY ON RED-TAILED HAWKS.
J. Wildl. Manage. 35(2): 293 - 300.

Six groups of one-year old red-tailed hawks (*Buteo jamaicensis*) of three birds each were fed chicks contaminated with methyl mercury at three different levels (3.9, 7.2, and 10.0 ppm of mercury were found in their livers, respectively). The experimental feeding periods were four or 12 weeks. Mortality occurred in the groups on the most contaminated diets after an exposure period of one month or more, the signs of poisoning prior to death being essentially neurological. The mercury levels in the livers of hawks that succumbed to mercury poisoning were abour 20 ppm. These hawks, and those that survived on the two most heavily contaminated diets, showed pathological changes. The most consistent changes were swelling of axons of myelinated nerves in the spinal cord, with dilatation of myelin sheaths and loss of myelin.

81. Fimreite, N., R. W. Fyfe, and J. A. Keith. 1970.
MERCURY CONTAMINATION OF CANADIAN PRAIRIE SEED EATERS AND THEIR AVIAN PREDATORS.
Can. Filed Nat. 84 (3): 269 - 226.

The investigation revealed that mercury contamination is rather widespread in prairie wildlife. Livers of seed-eaters shot on fields sown with treated grain contained significantly higher mercury levels than those shot on untreated fields, strongly suggesting mercury seed dressings as the major source of contamination. This suggestions is supported by mercury concentrations both in seed-eaters and in their avian predators being significantly higher in specimens from Alberta, where the use of mercury seed dressings is widespread, than in Saskatchewan where seed treatment is much less common.

82. Fimreite, N., W. N. Holsworth, J. A. Keith, P. A. Pearce, and I.M. Gruchy. 1971.
MERCURY IN FISH AND FISH-EATING BIRDS NEAR SITES OF INDUSTRIAL CONTAMINATION IN CANADA.
Can. Field Nat. 85(3): 211 - 220.

Concentrations of mercury were determined in fish muscle, livers and eggs of fish-eating birds, and bivalve molluscs. Most of the material was collected near sites of industrial contamination: a mercury mine, chloralkali plants and pulp mills known to use or have used mercury. Most sites showed substantial mercury contamination, especially downstream from the above sources. Mercury levels exceeding 0.5 ppm were found in practically all samples of freshwater fish. Individual walleye (Lake St. Clair), pumpkinseed (St. Clair River), and lake trout (Pinchi Lake) contained concentrations up to 5.01, 7.09, and 10.50 ppm of mercury respectively. Lower levels were found in marine fishes from coastal waters. A positive correlation was found between body weight and mercury concentration in most fish samples, and also between the trophic feeding level and mercury concentration in both fish and fish-eating birds. The highest mercury level in the livers of fish-eating birds was 17.40 ppm (red-necked grebe). Four common tern eggs averaged 0.58 ppm and two red-breasted merganser eggs averaged 0.81 ppm. The mercury concentrations are discussed in terms of published data on hazard to human health and to reproduction in fish-eating birds.

83. Finegan, R. P. 1967.
ENVIRONMENTAL CONTAMINATION BY BENZENE HEXACHLORIDE USED FOR CONTROL OF AMBROSIA BEETLE.
British Columbia Dept. Rec. Conserv. Wildl. Manage. Div. 8 pp.

The paper explains how benzene hexachloride disrupts food chains. There is also mention of the effect on peregrine falcon eggs.

84. Fink, R. J. 1975.
THE EFFECT OF SIMAZINE ON THE REPRODUCTIVE CAPACITY OF MALLARD DUCKS.
Toxicol. Appl. Pharmacol. 33(1): 188 - 189.

This study was designed to investigate the effect of simazine (a triazine herbicide) on the reproductive capability of mallard ducks. The birds were exposed to simazine at dietary levels of 2.0 and 20.0 ppm from prior to the onset of egg laying through the normal egg production cycle. Reproductive impairment was evaluated by analysis of the following reproductive parameters: egg laid, eggshell cracks, viable embryos, live three-week embryos, normal hatchlings, 14-day-old survivors, and eggshell thinning. Statistical analysis of the reproductive parameters revealed that simazine caused no reproductive impairment in mallard ducks.

85. Flicklinger, E. L., and K. A. King. 1972.
SOME EFFECTS OF ALDRIN-TREATED RICE ON GULF COAST WILDLIFE.
J. Wildl. Manage. 36(3): 706 - 727.

Dead waterfowl, shorebirds, and passerines were collected on study areas in Wharton, Vrazoria, and Chambers counties, Texas, from 1967 through 1971. Residues of aldrin or dieldrin were found in all samples of bird casualties and in all eggs, scavengers, predators, fish, frogs, invertebrates, and soils. Fulvous tree ducks appeared to be less resistent to aldrin than other ducks. Dieldrin residues in brains of dead fulvous tree ducks were low, but whole-body residues were as high as 16 ppm. Brains of other dead ducks and geese averaged 10 ppm dieldrin. Some dead birds were exposed by eating treated rice seed, but many dead birds with high dieldrin residues were species that feed largely on invertebrates.

86. Floru, A., A. Polizu, and L. Manolache. 1973.
STUDIES ON THE RESIDUES OF SOME ORGANOCHLORINE INSECTICIDES IN PHEASANTS.
Stud. Cercet. Biol. Ser. Zool. 25(5): 501 - 505. [In Romanian, English Summary].

BHC and DDT residues in various pheasant organs were evaluated. The highest values were found in fat, and the lowest in meat; eggs had fairly high residual values. The values obtained during spring and autumn were slightly higher than those of summer.

87. Fowle, C. D. 1972.
EFFECT ON PHOSPHAMIDON ON FOREST BIRDS IN NEW BRUNSWICK.
Can. Wildl. Serv. Report. Ser. No. 16

The study discusses the following topics: (1) varying amounts of phosphamidon used, (2) varying dilutions with water, (3) time of year to spray, and (4) two applications.

88. Frank, R., M. V. H. Holdrinet, and W. A. Rapley. 1975.
RESIDUE OF ORGANOCHLORINE COMPOUNDS AND MERCURY IN BIRDS EGGS FORM THE NIAGARA PENINSULA, ONTARIO.
Arch. Environ. Contam. Toxicol. 3(2): 205 - 218.

Eggs (307) were collected in 1971 from twenty species of birds with a variety of feeding habits from the Niagara Peninsula. This area of Ontario is intensively developed for agriculture and heavy industry and has a large urban population. Representative species were obtained from both the terrestrial and aquatic food chains. Eggs were analyzed for organochlorine insecticides, polychlorinated biphenyls, and total mercury.

89. Franson, J. C., P. A. Dahm, and L. D. Wing. 1974.
CHLORINATED HYDROCARBON INSECTICIDE RESIDUES IN ADIPOSE, LIVER, AND BRAIN SAMPLES FROM IOWA MINK.
Bull. Environ. Contam. Roxicol. 11(4): 379 - 385.

Chlorinated hydrocarbon insecticide residues in the mink were quantified in adipose, liver, and brain tissues, and the relationship between age and insecticide level was examined. Total residues of DDT and related compounds ranged from 0.27 to 9.51 ppm. The highest levels of DDT and related compounds correlated with high adipose levels. The residues of the individual insecticides would probably have little effect on reproductive performance, but the synergistic effect of all chlorinated hydrocarbons is unknown.

90. Freeman, H. C. 1973.
MERCURY IN CANADIAN SEALS.
Bull. Environ. Contam. Toxicol. 10(3): 172 - 180.

Methylmercury was found in grey, ringed, and bearded seals. Low Hg levels suggested that seals may have a process of mercury demethylation which would lead to greater excretion of Hg.

91. Friend, N., and D. O. Trainer. 1972.
DUCK HEPATITIS VIRUS INTERACTIONS WITH DDT AND DIELDRIN IN ADULT MALLARDS.
Bull. Environ. Contam. Toxicol. 7(4): 204 - 206.

The effect of duck hepatitis virus infection on the toxicity of p, p' DDT and technical grade dieldrin in adult mallards was studied. Biological interactions between organochlorine chemicals and the infectious disease agent are considered.

92. Fryer, G. 1973.
UNUSUAL EGG SPOILAGE IN THE COMMON FROG.
Naturalist 926: 105 - 106.

No abstract located.

93. Fyfe, R. W., R. W. Risebrough, and W. Walker II. 1976.
POLLUTANT EFFECTS ON THE REPRODUCTION OF THE PRAIRIE FALCONS AND MERLINS OF THE CANADIAN PRAIRIES.
Can. Field. Nat. 90 (3): 346 - 355.

Studies of the pollution ecology of the prairie falcon (*Falco mexicanus*) and the Richardson's merlin (*Falco columbarius richardsonii*) carried out by the Canadian Wildlife Service in Alberta and adjacent regions of western Canada have shown that both species have been stressed by residues of p,p' - DDE accumulated from food webs. Reproduction of the more contaminated members of both populations was significantly decreased. Changes in nest defence behvoir of merlins were significantly associated with decreasing shell-thickness index and increasing levels of DDE and possibly of PCB: more contaminated individuals were less aggressive in defending territories. DDE levels in the eggs associated with decreases in productivity were approximately 10 ppm dry weight (2 ppm wet weight) in prairie falcon eggs and 30 ppm dry weight (6 ppm wet weight) in merlin eggs. Effects of current levels of PCB, dieldrin, haptachlor epoxide, and mercury on the reproduction of these populations could not be demonstrated, mean concentrations of these pollutants in eggs appeared to be below threshold levels. Pollutant levels in addled eggs and in eggs containing dead embryos were not significantly different from those in viable eggs.

94. Fyfe, R. W., J. Campbell, B. Hayson, and K. Hodson. 1969.
REGIONAL POPULATION DECLINES AND ORGANOCHLORINE INSECTICIDES IN CANADIAN PRAIRIE FALCONS.
Can. Field Nat. 83(3): 191 - 200.

Investigations into the status of prairie falcons in western Canada were carried out in 1966, 1967 and 1968. Samples were collected and residue analyses conducted on egg contents and tissue samples. The field investigations show a 34 percent reduction in the occupancy of territories known in the previous 10 years. This reduction has been concentrated in a four or six areas studied, and current nestling production is also lowest in three of these same four areas (nestling data for the fourth area lacking). All egg and tissue samples analyzed contain organochlorine insecticide residues, principally DDE, with generally smaller amoutns of heptachlor epoxide and dieldrin. Total residues in eggs ranged from 1 - 22 ppm wet weight, but levels in the samples within each area were similar. A comparison of eggshell thickness to DDE levels in the eggs shows a decrease in shell weight and thickness with increasing DDE levels. These shells are significantly thinner than shells of eggs laid before the widespread use of organochlorine insecticides. High heptachlor epoxide levels may have caused the death of four young falcons, and high DDE levles may have caused the hatching failure of two fully-developed and thin-shelled falcon eggs. Areas with the lowest rate of production of nestling falcons were also the areas with the highest DDE levels in falcon eggs.

95. Gardiner, E.E. 1972.
DIFFERENCES BETWEEN DUCKS, PHEASANTS, AND CHICKENS IN TISSUE MERCURY RETENTION, DEPLETION, AND TOLERANCE TO INCREASING LEVELS OF DIETARY MERCURY.
Can. J. Anim. Sci. 52(2): 419 - 423.

Ducks, pheasants, and broiler-type chickens were fed from five days of age diets containing four levels of added mercury (00, 0.33, 3.3 and 33 ppm) from methyl mercury dicyandiamide. At 35 days of age, heart, liver, kidney and breast tissues were taken for mercury analyses. Birds receiving 0.33 and 3.3 pp of mercury were changed to the 0.0 ppm diet after 35 days and the four tissues were removed weekly for nine weeks. Body weight at 35 days was lower in all three species on the 33 ppm diet than on the other three diets. Mortality on the 33 ppm diet was 90, 85 and 7.5 percent for pheasants, ducks and chickens, respectively. Background tissue mercury levels (0.0 ppm added mercury diet) were higher in liver and kidney than in heart and breast. Relative tissue mercury levels for the other three treatments at 35 days of age were: heart $<$ breast $<$ liver $<$ kidney. Tissue mercury levels were generally higher in ducks than in pheasants and higher in pheasants than in chickens. Ducks retained more mercury in their tissues over time after they were placed on the 0.0 ppm diet than pheasants and pheasants retained more than chickens.

96. Gatzey, J. T., and M. J. Stutts. 1975
ION TRANSPORT AND OXYGEN CONSUMPTION OF EXCISED BULL FROG LUNG AFTER TREATMENT WITH MERCURIC CHLORIDE OR AMPHOTERICIN B (AmB).
Proc. Federat. Am. Soc. Biol. 34(3): 753.

The results suggest that the initial stimulation of spontaneous transmural P.Dl (ΔE) and short-circuit current after $HgCl_2$ results from increased Cl-secretion across the apical membranes of the alveolar epithelial cells, whereas AmB induces an increase in passive Na+ entry across the same barrier. The fall in ΔE is compatible with an increase in the overall ion permeability of the epithelium.

97. Gilbertson, M., and L. M. Reynolds. 1972.
HEXACHLOROBENZENE IN THE EGGS OF COMMON TERNS IN HAMILTON HARBOUR, ONT.
Bull. Environ. Contam. Toxicol. 7(6): 371 - 373.

This paper presents information on the fungicide hexachlorobenzene in the eggs of common terms in Hamilton Harbour, Ontario. The eggs were tested for the fungicide as well as other polychlorinated pesticides. The testing procedures are outlined and the results are presented in table form. The fungicide is believed to originate from various industrial activities located around the harbour.

98. Giles, R. H., Jr. 1970.
THE ECOLOGY OF A SMALL FORESTED WATERSHED TREATED WITH THE INSECTICIDE MALATHION - S^{35}.
Wildl. Monogr. 24. 81 pp.

Reptiles and amphibians were unaffected. Birds seemed to react to the insecticide for two days but no lasting effects were noted. Populations of mice and chipmunks appeared to be reduced at least by 30 percent on the treated area. Shrews and larger animals apparently were unaffected. Effects on lower animals and plants were also studied.

99. Gillett, J. W., ed. 1970.
THE BIOLOGICAL IMPACT OF PESTICIDES ON THE ENVIRONMENT.
Oregon State Univ., Corvallis.

Proceedings of a symposium directed at the significance of pesticides in relation to ecological problems and health. Various papers discuss transport and accumulation of pesticides in ecosystems, the impact of chlorinted hydrocarbons on birds, the effects of pesticides on fish, health and neurophysiological effects in mammals and a general history on reasons why pesticides are used.

100. Gillett, J. W., and G. H. Arscott. 1969.
MICROSOMAL EPOXIDATION IN JAPANESE QUAIL: INDUCTION BY DIETARY DIELDRIN.
Comp. Biochem. Physiol. 30(4): 589-600.

Dieldrin, fed at 5 ppm without toxicity to 1-week old Japanese quail chicks, effectively increases aldrin epoxidase activity of hepatic microsomes, but does not affect cytochrome P-450 or NADPH-neotetrazolium reductase levels. Levels of epoxidase, P-450 and neotetrazolium reductase do not vary significantly between 3 strains of quail or between the sexes. Epoxidase activity declines with age, whereas P-450 levels increase in maturing chicks. DDT, fed at 100 ppm for several months, causes depression of hepatic microsomal activities in mature quail. Ring-necked pheasants from a DDT-treated area are similarly affected.

101. Good, E. E., and G. W. Ware. 1969.
EFFECTS OF INSECTICIDES ON REPRODUCTION IN THE LABORATORY MOUSE. IV. ENDRIN AND DIELDRIN.
Toxicol. Appl. Pharmacol. 14(1): 201-203.

A single large-scale feeding test was conducted on CFW Swiss mice to measure the influence of sublethal levels of dietary organochlorine insecticides on reproduction. Endrin and dieldrin were fed at 5 ppm for 120 days, beginning 30 days before mating. Endrin produced significant parent mortality, and significantly smaller litters. Dieldrin, a stereoisomer of endrin, produced no parent mortality, but significantly reduced the size of all litters. Neither compound affected fertility, fecudnity, or the number of young produced per day.

102. Gough, B. J., L. A. Escurieux, and T. E. Shellenberger. 1967.
COMPARATIVE TOXICOLOGIC STUDY OF A PHOSPHORODITHIOATE IN JAPANESE QUAIL AND BOBWHITE QUAIL.
Toxicol. Appl. Pharmacol. 11(1): 12 - 19.

Guthion had a significant effect on growth of female but not male Japanese quail at a dietary level of 540 ppm; with bobwhite, growth was significantly reduced at 20 ppm. All birds of both species died during the first 10 days of feeding at 1620 ppm. With bobwhite, 80% mortality was obtained at 540 ppm and 30 percent at 180 ppm whereas there was no increase above normal in mortality of Japanese quail at 180 ppm or 540 ppm. Egg production of Japanese quail was delayed and markedly reduced at 540 ppm; total egg hatchability at 180 and 540 ppm was somewhat lower than obtained in the control birds. Whole blood or brain cholinesterase of both species was inhibited after four and ten weeks at 60 ppm; there was somewhat greater inhibition in bobwhite. Results indicate that bobwhite quail were more sensitive to guthion than Japanese quail.

103. Greenberg, R. E., and W. R. Edwards. 1970.
INSECTICIDE RESIDUE LEVELS OF WILD PHEASANTS IN ILLINOIS.
Trans. Illinois State Acad. Sci. 63(2): 136 - 147.

Pheasant eggs were sampled from cultivated regions dominated by grain farming. Aldrin and DDT were detected in 119 of 120 eggs, heptachlor residues were found in 61 of 120 eggs.

104. Greenwood, R. J., Y. A. Greichus, and E. J. Huggins. 1967.
INSECTICIDE RESIDUES IN BIG GAME MAMMALS OF SOUTH DAKOTA.
J. Wildl. Manage. 31(2): 288 - 292.

An analysis was made of eight insecticide residues in the rneal fat tissue of 23 white-tailed deer (*Odocoileus virginianus*), 13 mule deer (*O. hemionus*), nine pronghorns (*Antilocapra americana*) and two elk (*Cervus canadensis*) collected in South Dakota during the fall of 1964. Identification and quantitative analysis of the insecticide residues were accomplished by thin-layer and gas-liquid chromatography. Eight-five percent of the samples had residues of DDT with an average of 0.13 ppm. DDD residues were found in 11 percent of the samples, DDE in 38 percent, dieldrin in 38 percent, and lindane in 15 percent with an average of 0.07, 0.04, 0.03 and 0.04 ppm, respectively. Heptachlor, heptachlor epoxide, and aldrin were not detected in concentrations above the limits of the experiment set by the investigators.

105. Greichus, Y. A., A. Greichus, and R. J. Emerick. 1973.
INSECTICIDES, POLYCHLORINATED BIPHENYLS, AND MERCURY IN WILD CORMORANTS, PELICANS, THEIR EGGS, FOOD, AND ENVIRONMENT.
Bull. Environ. Contam. Toxicol. 9(6): 321 - 328.

Mercury was the highest in the liver of cormorants and pelicans. Cormorant eggs were found to have higher levles of insecticides, PCBs and mercury than pelican eggs.

106. Greichus, Y. A., A. Greichus, and E. C. Reider. 1968.
INSECTICIDE RESIDUES IN GROUSE AND PHEASANTS OF SOUTH DAKOTA.

Pestic. Monit. J. 2: 90 - 92.

Pheasants (*Phasianus colchicus*) and sharp-tailed grouse (*Pedioecetes phasianellus campestris*) of South Dakota were analyzed for the presence of nine chlorinated hydrocarbon insecticide residues by gas-liquid and thin layer chromatography. Minimum experimental levels were set at 0.01 ppm for lindance, heptachlor, heptachlor epoxide, aldrin, dieldrin, DDE and DDD (TDE), and 0.05 ppm for DDT and endrin. Eight residues were detected in these birds. Endrin was not found at levels above 0.05 ppm. Heptachlor and aldrin were found at low levels in a few birds. The combined levels at DDT, DDD, and DDE averaged 0.27 ppm in grouse and 0.37 ppm in pheasants. Lindane was not detected above 0.01 ppm in approximately 75 percent of the grouse and pheasants, and the remainder of the birds had residues below 0.2 ppm. Dieldrin was found in greater concentration in grouse (0.17 ppm versus 0.08 ppm), and heptachlor epoxide levels were higher in the pheasants (0.06 ppm versus 0.02 ppm). The average amount of all chlorinated hydrocarbon insecticides found in the fat of grouse and pheasants in this study was 0.5 ppm.

107. Grier, J. W. 1975.
REPRODUCTION, ORGANOCHLORINES, AND MERCURY IN NORTHWESTERN BALD EAGLES.
Can. Field Nat. 88(4): 469 - 476.

A yearly census of bald eagles (*Haliaeetus leucocephalus*) in northwestern Ontario (Canada) revealed a significant decline ($P < 0.05$) from 1966 through 1973 in the percentage of potential breeding areas that actually produced nestlings (range of 74 percent to a low of 36 percent). The average number of young per nest with young (1.5 overall) did not vary significantly during this period. Residue levels of several toxic chemicals except Hg were high in addled eggs, averaging on a dry-weight basis 94 ppm p,p'-DDE, 5.2 ppm dieldrin, 434 ppm PCB (polychlorinated biphenyls) and 2.5 ppm Hg. The shells of these eggs were signficantly thinner ($P < 0.05$) than those of eggs collected before 1947. Toxicant residue levels of eagle eggs in this region are substantially higher than in the tissues of a dead nestling eagle or in the eggs of ospreys (*Pandion haliaetus*) in the same region. The high PCB values suggest that the eagles are acquiring the toxicant burden outside of the nestling region.

108. Grocki, D.R. J., and D. W. Johnson. 1974.
CHLORINATED HYDROCARBON PESTICIDES IN NORTH AMERICAN CUCKOOS.
Auk 91(1): 186 - 188.

Hundreds of small birds are killed each autumn and spring at television towers in Florida, and from these, large samples were selected for an inital report data from a series of chiefly insectivorous cuckoos, 16 yellow billed

-8

[*Coccyzuz americanus*] and one Black-billed [*C. erythropthalmus*]. Collection dates were from autumn 1970 through spring 1973.
Dieldrin occurred in one-half of the birds in low concentrations (Mean = 0.07 ppm.) Total DDT burdens in the adipose tissue were low, ranging from 0 to 3.34 ppm liquid weight (mean = 0.88). No mirex or PCBs were detected in any of the samples. Adults had higher total DDT levels than first-year birds in autumn. This is not an unexpected result inasmuch as an adult would have longer to accumulare pesticides than a bird-of-the-year.

109. Grolleau, G., LaVaur, R. and Siou, G. 1974.
EFFECTS OF 2,4-D ON THE REPRODUCTION OF QUAIL AND PARTRIDGE, AFTER SPRAYING THE PRODUCT ON THE EGGS.
Annale. Zool. - Ecol. Animal. 6(2): 313-331.

The study of effects on the reproduction of 2, 4-dichlorophenoxy acetic acid (2,4-D), in the form of salt of dimethylamine has been undertaken in the quail, *Coturnix coturnix japonica* L., in grey partridge, *Perdix perdix* L. and red partridge *Alectoris rufa* L.
Application of the product was done by spraying 2,4-D on eggs at three different doses. The first one corresponded with the normal treatment as herbicide of cereals: 1.2 kg/ha, second 2.4 kg/ha and the third one 6 kg/ha of acid 2,4-D. The preliminary study on quail consisted of the determination of rate of hatching and percentage of mortality of embryos and in the youngs during their first month of life; as well the study of teratogenetic malformations in the youngs at the time of hatching and in non-hatched embryos. From the results, no evidence is shown of noxious effects of 2,4-D on the parameters studied. Similarly it was possible to evaluate the rate of spontaneous malformations that can be observed in Japanese quail.

Experimentation on partridge comprised of besides the parameters mentioned above, the histopathological examination of thyroids and similarly attempts to try to establish a relation between the toxic effects observed and amount of residues of 2,4-D found in the eggs. No noxious effect has been revealed, though there is a slight decrease in the rate of viability of youngs of grey partridge emerged from treated eggs at the dose of 6 kg/ha. The determination of residues of 2,4-D, carried out only in the eggs of grey partridge treated at the dose of 6 kg/ha, has shown that residues in embryo and in the rest of egg were less important. The weak dose of 2,4-D passing through shell explains certainly the absence of remarkable toxic effects of spraying done on the eggs.

110. Gurba, J. B., ed. 1970.
MERCURY SITUATION IN ALBERTA.
Alberta Dept. Agric., Edmonton, Can.

No abstract could be located.

111. Guthrie, R. E., J. J. Domanski, A. A. Main, D. G. Sanders, and R. R. Monroe. 1974.
USE OF MICE FOR INITIAL APPROXIMATION OF REENTRY INTERVALS INTO PESTICIDE TREATED FIELD.
Arch. Environ. Contam. Toxicol. 2(3): 233-242.

Fifteen mice (five mice/cage) were transported to the application site each morning. Leaves were collected at the desired interval after initial application and placed in the bottom of the cage. Tobacco leaves lay flat on the bottom surface and a screen (2 x 2 in. mesh) held apple leaves flat on the cage bottom; the openings were of such size that the mice were forced to walk on the leaves rather than on the wire. At the time the animals were exposed, leaves from the same plots were collected, placed in plastic bags, and refrigerated. Mice were then returned to the laboratory and the leaves in the cage bottoms were replaced by refrigerated leaves every two hours. The mice were held on leaf surfaces for 10 hr. and sacrificed. Another group of 15 mice was taken to the field the next morning and the procedure repeated with leaves that had weathered for another 24-hour period. This procedure was repeated with a new group of mice each day until pre- and post-exposure plasma cholinesterase levels were the same. Pesticides used were malathion, methomyl, parathion, methyl parathion, azinphosmethyl, and monocrotophos.

112. Haegele, M. A., and R. K. Tucker. 1974.
EFFECT OF 15 COMMON ENVIRONMENTAL POLLUTANTS ON EGGSHELL THICKNESS IN MALLARDS AND CORTURNIX QUAIL.
Bull. Environ. Contam. Toxicol. 11(1): 98 - 102.

The capacity of 15 common pesticides and environmental pollutants to cause eggshell thinning was investigated. Except for the pattern shown by DEE, the shell thinning produced by the compounds tested appears to be associated with reduced food consumption caused by sublethal intoxication and could be termed toxic thinning. In contrast, the shell-thinning response to DDE appears to occurr in the absence of any other clinical sign of intoxication. Thus it appears that DDE, the major degradation product of DDT in the environment, can be a very quick-acting eggshell-thinning agent with long-term effects. This suggests that birds exposed to DDE on the winter grounds or during migration north could lay thin-shelled eggs, even though the food supply where they nested was not significantly contaminated.

113. Haegele, M. A., R. H. Hudson, and R. K. Tucker. 1972.
EFFECT OF AGE ON SENSITIVITY: ACUTE ORAL TOXICITY OF 14 PESTICIDES TO MALLARD DUCKS OF SEVERAL AGES.
Toxicol. Appl. Pharmacol. 22(4): 556-561.

Acute po LD50 values for 14 common pesticides (four central nervous system stimulants and 10 anticholinesterases) were determined on mallard ducks (*Anas platyrhynchos*) aged 36 hr, seven days, 30 days, and 6 mo. The youngest mallards were more sensitive than the oldest to six compounds and less sensitive to eight. The extremes in susceptibility to a compound between age groups were generally less than three-fold. The four central nervous system stimulants produced LD50 values that decreased from 36 hr. to seven or 30 day old animals, and increased from animals aged seven or 30 days to six mo. Eight of the 10 anticholinesterase compounds produced LD50 values that increased from 36 hr. to seven or 30 day old animals, and decreased from animals aged seven or 30 days to six mo. The results indicate that young animals are not always more susceptible to pesticides than adults of a species. It was recommended that age-susceptibility factors be considered in the development of standardized toxicological protocols.

114. Haegele, M. A., R. K. Tucker, and R. H. Hudson. 1974.
EFFECTS OF DIETARY MERCURY AND LEAD ON EGGSHELL THICKNESS IN MALLARDS.
Bull. Environ. Contam. Toxicol. 11(1): 5-11.

Neither lead nor mercury contributed significantly to mallard eggshell thinning, nor did these compounds appear to act synergistically with DDE. Although these results suggest that lead and mercury do not contribute to eggshell thinning in brown pelicans, it is possible that as a result of subtle differences in reproductive physiology between captive mallards and brown pelicans, mercury and lead could still act synergistically with DDE to cause the extreme degree of shell thinning experienced by the Anacapa brown pelicans. However, the authors believe it is more likely that either innate differences in reporductive physiology, or differences due to unknown contaminats or stresses, have contributed to the greater degree of shell thinning attributed to DDE in brown pelicans.

115. Hague, R., and V. H. Freed., eds. 1975.
ENVIRONMENTAL DYNAMICS OF PESTICIDES.
Plenum Press, New York. 387 pp.

Papers on behaviour of chemicals in air, water, soil and biota, and includes such topics as modelling in the environment, adsorption, leaching, vapor loss, etc. The contributors represent academic, industry and gov't laboratories.

116. Hallett, D. J., R. J. Nostrom, F. I. Onuska, M. Comba, and R. Sampson. 1976.
DETERMINATION OF PCBs IN MIREX IN LAKE ONTARIO HERRING GULLS.
International Conference on Environmental Sensing and Assessment: Vol. 1
Inst. Electrical Electronics Eng. New York.

PCBs coelute with mirex in residue cleanup procedures and peaks are superimposed under standard gas chromatographic conditions. Samples were perchlorinated to remove this interference. Whole body lipids indicated relatively high concentrations of mirex, and a monodechlorinated degradation product of mirex, PCBs, and DDE are bioaccumulated in the food web. These residues were most likely absorbed from a diet of lake fish and are a result of biomagnification of the organochlorine compounds from the lake water through the food web. Gulls have shown severe reproductive failures on Lake Ontario and appear to be useful bioindicators of persistent pollutants in the Great Lakes.

117. Hall, J. E., Y. A. Greichus, and K. E. Severson. 1971.
EFFECTS OF ALDRIN ON YOUNG PEN-REARED PHEASANTS.
J. Wildl. Manage. 35(3): 429-434.

Three levels of encapsulated aldrin (0.5, 1.0 and 1.5 mg) were administered weekly to pen-reared pheasants (*Phasianus colchicus*) from five to 11 weeks of age, or until birds were sacrificed, to determine effects on growth and to ascertain residue levels in brains and bodies at various periods after treatment was initiated. Growth of pheasants between five and twenty-one weeks of age was depressed (P 0.01) by administration of weekly aldrin dosages of 1.0 and 1.5 mg. Dieldrin values in brains and bodies increased proportionately with treatment levels during the period of administration, whereas aldrin did not increase. Ten weeks after treatments were terminated, brain and body levels of dieldrin from birds surviving the experiment were comparable to those of controls. Administration of 1.5 mg of aldrin in a single dosage caused the death of 11 of 22, five-week-old pheasants within 48 hours. Mean levels of aldrin plus dieldrin in these 11 birds were: brains, 2.72 ppm (2.13 - 4.25 ppm range); bodies, 2.38 ppm (1.45 - 4.35); and feathers, 0.81 ppm (0.56 - 1.43).

118. Hamrick, W. 1971.
THE EFFECTS OF ARASAN - ENDRIN TREATED PINE SEED ON BOBWHITE QUAIL, GREY SQUIRREL, AND TURKEY.
M.S. thesis, Auburn University. 47 pp.

Quail offered a choice of treated and untreated seed suffered 54 per cent mortality and all surviving birds exhibited symptoms of poisoning similar to the symptoms shown by birds force-fed treated seed. One ot two squirrels offered treated signs of poisoning. Turkeys offered the choice exhibited no external ill effects.

119. Hattori, K. 1974.
TOXICOLOGICAL STUDIES ON THE EFFECTS OF CHEMICALS ON BIRDS. PART 2 ACUTE ORAL TOXICITY OF FENITROTHION, TRICHLORFON, AND DICHLORVS IN THE COMMON PIGEON.
Hokkaidoritsu Eisei Kenkyusho Ho 24: 154. [In Japanese].

No abstract located.

120. Heath, R. G., and S. A. Hill. 1984.
NATIONWIDE ORGANOCHLORINE AND MERCURY RESIDUES IN WINGS OF ADULT MALLARDS AND BLACK DUCKS DURING THE 1969 - 1970 HUNTING SEASON.
Pestic. Monit. J. 7(3/4): 153 - 165.

Nationwide monitoring of organochlorine pesticides in wings of more than 24,000 mallards and black ducks bagged during the 1965 and 1966 hunting seasons showed DDE to be the predominant residue, followed in order by DDT, DDD, dieldrin, and heptachlor epoxide. Residues were generally highest in wings from the Atlantic and Pacific Flyways, and lowest in the Central Flyway. DDE was reported for every State and was notably high in wings from New Jersey, Massachusetts, Connecticut, Rhode Island, New York, Pennsylvania, Alabama, California, and Utah. Dieldrin residues were prevalent in wings from Arkansas, Texas, Utah, California, and several States in the Atlantic Flyway.

121. Heath, R. G., J. W. Spann, E. F. Hill, and J. F. Kreitzer. 1972.
COMPARATIVE DIETARY TOXICITIES OF PESTICIDES TO BIRDS.
U. S. Bur. Sport Fish. Wildl. Spec. Sci. Rep. 151 61 pp.

Measurements of the lethal dietary toxicity of 89 pesticidal chemicals to young bobwhites, Japenese quail, ring-necked pheasants and mallards. Toxicity is expressed as the median lethal concentration (LC 50) of active chemicals in a five day ad libitum diet. LC 50 and associated statistics are derived by methods of profit analysis. Endrin consistently was the most toxic chemicals of those tested on all species. In general, organophosphates were less toxic than aldrin of dieldrin and herbicides were of a low order of toxicity.

122. Heinz, G. 1974.
EFFECTS OF LOW DIETARY LEVELS OF METHYL MERCURY ON MALLARD REPRODUCTION.
Bull. Environ. Contam. Toxicol. 11(4): 386 - 392.

Mallard ducks were fed a control diet of 0.5 ppm or 3.0 ppm methyl mercury dicyandiamide. 3.0 ppm has no observed effect on health of adults during 12 months of dosage but had effects on reproduction. The methyl mercury caused: (1) increase in duckling mortality, (2) reduced egg laying, and (3) increased embryonic mortality. There was no apparent egg shell thinning.

123. Heinz, G. 1975.
EFFECTS OF METHYL MERCURY ON APPROACH AND AVOIDANCE BEHAVIOUR OF MALLARD DUCKLINGS.
Bull. Environ. Contam. Toxicol. 13(5)L 554 - 564.

Mallard ducks were fed a control diet or a diet containing 0.5 or 3 ppm mercury (as methylmercury dicyandiamide) based on the dry feed. These mercury diets are approximately equivalent to 0.1 and 0.6 ppm mercury in a natural succulent diet. Measurements were taken of the ducklings approach behaviour in response to a tape-recorded maternal call, and of the avoidance of a frightening stimulus.

There were no significant differences among controls and ducklings from mercury-treated parents in the percentage of ducklings that approached the tape-recorded call. Control ducklings, however, moved back and forth toward the call more than ducklings from mercury-treated parents and also spent more time in the end of the runway near the loudspeaker than ducklings whose parents were fed a diet containing 0.5 ppm mercury. Compared to control ducklings, ducklings from parents fed a diet containing 0.5 or 3 ppm mercury were hyper-responsive in the test of avoidance of a frightening stimulus.

124. Heinz, G. H. 1976.
METHYMERCURY: SECOND GENERATION REPRODUCTIVE AND BEHAVIORAL EFFECTS ON MALLARD DUCKS.
J. Wildl. Manage. 40(4): 710 - 715.

Mallard ducks (*Anas platyrhynchos*) whose parents were fed a diet containing 0.5 ppm mercury (equal to about 0.1 ppm mercury in a natural diet) were also fed a diet containing 0.5 ppm mercury beginning at nine days of age and continuing through their reproductive season. Mercury in the eggs of treated hens average 0.86 ppm. Hens fed 0.5 ppm mercury made less efficient use of feed and laid a greater percentage of eggs outside nestboxes compared with controls. Hens fed mercury also produced fewer one-week-old ducklings than did controls. There were no significant differences between controls and ducklings from parents fed 0.5 ppm mercury in approach responses to tape-recorded maternal calls, in avoidance of a frightening stimulus, or in open-field behavior. Ducklings from parents fed 0.5 ppm mercury did not grow as fast as did control ducklings.

125. Heinz, G. H. 1976.
METHYLMERCURY: SECOND-YEAR FEEDING EFFECTS ON MALLARD REPRODUCTION AND DUCKLING BEHAVIOR.
J. Wildl. Manage. 40(1): 82 - 90.

For two consecutive years mallard (*Anas platyrhynchos*) hens were fed a control diet or a diet that contained 0.5 or 3 ppm mercury averaged 0.79 and 5.46 ppm, respectively; on a dry-weight basis, the concentrations of mercury in eggs was 4.88 times as great as that in the feed ducks fed 0.5 ppm mercury and 5.64 times as great for ducks fed 3 ppm mercury. There were no significant differences in egg production or hatching success among controls and groups fed mercury. Ducklings from hens fed 3 ppm mercury were less likely to survive to one week of age than were controls or ducklings from parents fed 0.5 ppm mercury. There were no significant differences in approach behavior among the offspring of controls and groups fed mercury. In avoidance behavior ducklings whose parents were fed 3 ppm mercury were hyper-responsive compared with controls and ducklings from parents fed 0.5 ppm mercury.

126. Heinz G., and L. N. Locke. 1976.
BRAIN LESIONS IN MALLARD DUCKLINGS FROM PARENTS FED MEHTYLMERCURY.
Avian Dis. 20(1): 9 - 17.

Methylmercury dicyandiamide was fed to mallard ducks at 3 ppm mercury. Mercury accumulated in the eggs to an average of 7.18 and 5.46 ppm on a wet-weight basis in two successive years. Mercury in the eggs is believed to have caused brain lesions in the hatched ducklings. Lesions included demyelination, neuron shrinkage, necrosis, and hemorrhage in the meninges overlying the cerebellum. Brains of dead ducklings contained an average of 6.17 and 5.19 ppm mercury on a wet-weight basis in two successive years.

127. Helminen, M., and T. Rattis. 1969.
THE TOXICITY AND IMMEDIATE EFFECTS UPON GAME ANIMALS OF 2, 4-D AND 2, 4, 5-T HERBICIDES.
Suomen Riista 21: 7 - 15 [In Finnish, English summary]

To observe the immediate effects of these herbicides upon pheasants two simple experiments were carried out at the Evo Game Research Station in the summer of 1968. The feathers of the back and shoulders, the bottom of the cage, and the fodder (oats) of seven pheasnats were thoroughly sprayed with 2,4,5-T emulsion without any visible adverse effect upon the birds.

The behavior of 10 pheasants in an enclosure with sprayed patches was followed. No immeidate repelling effect was observed. Only about two weeks after the treatment, when the vegetation was already clearly withered, did the birds start to avoid the sprayed patches. No visible health hazard was ascertained.

The theory that these herbicides constitute a relatively slight danger to game anaimals is further supported by the fact that no case of herbicide poisoning has so far been diagnosed in Finland. Despite their low acute toxicity the herbicides may be important factors influencing the local game densities, since killing of hard-wood coppice by any menas usually results in an essential deterioration of the habitat. These indirect effects of the herbicides used in silviculture are presently being investigated by the State Game Research Institute.

128. Hendrickson, C.M., and J. A. Bowden. 1975.
THE IN VITRO INHIBITION OF RABBIT MUSCLE LACTATE DEHYDROGENASE IN MIREX AND KEPONE.
J. Agric. Food Chem. 23(3): 407 - 409.

Lactate dehydrogenase is competitively inhibited by mirex and kepone (a carbonyl analog of mirex) at levels greater than 0.01mM (10 ppm) during in virto determinations. This inhibition occurs at test levels well below usual lethal dosages and comparable to accumulation concentrations. Because lactate dehydrogenase occupites a key position in the anaerobic glycolytic pathway of skeletal muscle (one of several tissues which accumulates mirex), impairment of the function of this enzyme in energy production could result in possible harmful effect on muscle function.

129. Herrick, G. M., J. L. Fry, W. G. Fong, and D. C. Golden. 1969.
PESTICIDE RESIDUES IN EGGS RESULTING FROM THE DUSTING AND SHORT-TIME FEEDING OF CHLORINATED HYDROCARBON INSECTICIDES TO HENS.
J. Agric. Food Chem. 17(2): 291 - 295.

The dusting of laying hens with "safe" insecticides contaminated with as little as 200 ppm of DDT caused residues in the egg to exceed the working level. Dusts with up to 300 ppm of BHC did not exceed 0.05 ppm in the eggs. A dust contaminated with 2000 ppm of methoxychlor produced no detectable residues. Chlorinated hydrocarbon insecticides were fed at low levels to laying hens for a one-week period. The insecticides, feeding levels, and maximum residue amounts in the whole eggs were: DDT 0.33 ppm in feed, 0.062 ppm in eggs; aldrin 0.114 ppm in feed, dieldrin 0.011 ppm in eggs; lindane 0.26 ppm in feed, 0.033 ppm in eggs; chlordane 0.08 ppm in feed, no detectable residues in eggs.

130. Hilbig, V.V., K. Lucas, and V. Sebek. 1976.
STUDIES ON TOXIC EFFECTS OF 2,4-D and 2,4-T ON PHEASANTS, QUAIL AND CHICKEN EGGS.
Anz. Schädlingskde Pflanzenschutz Umweltschutz 49: 21-25. [In German, English summary].

Studies were performed on a total of 3,693 eggs from Japanese quails, 1,080 eggs from pheasants and 500 hens' eggs to investigate the possible effect of 2,4-D or a mixture of 2,4-D amd 2,4,5-T on the hatching rate, body weight and malformations of offsprings.

Non-incubated and preincubated (three days) eggs were sprayed with up to 10 time the amount of herbicides normally used. The eggs serving as controls were treated with tap water.

As compared with the controls, the herbicides did not affect hatching rate, body weight or the number of malformations.

131. Hill, E. F. 1972.
AVOIDANCE OF LETHAL DIETARY CONCENTRATIONS OF INSECTICIDES BY HOUSE SPARROWS.
J. Wildl. Manage. 36(2): 635 - 639.

Avoidance of certain insecticides by birds was observed during subacute toxicity testing. The capability of the house sparrow (*Passer domesticus*) to detect lethal concentrations and to adjust its feeding habits accordingly were tested with the pesticidal compounds abate, bromophos, gardona, and DDT. The results indicated that the birds were aware of toxicants in their diets; subsequently, feeding rates were reduced, and if a choice of nontoxic feed was given they selected nontreated feed. Birds may survive when a choice between treated and nontreated food is available, if the treated food is of moderate to low toxicity. With highly toxic material, mortality may occur even though a choice is available. Temporary avoidance of food treated with abate was observed even when no choice was given, but ultimately it was accepted, presumably as an alternative to starvation. Gardona was the most readily accepted pesticide tested, although it was also avoided when a choice was given between treated and untreated feed.

132. Hill, E. F., R. G. Heath, J. W. Spann, and J. D. Williams. 1975
LETHAL DIETARY TOXICITIES OF ENVIRONMENTAL POLLUTANTS TO BIRDS.
U. S. Fish Wildl. Serv. Spec. Rep. 191. 61 pp.

This report is a compilation and alaysis of the results of nearly 10 years of testing the lethal dietary toxicities of pesticidal and industrial chemicals to young bobwhites (*Colinus virginianus*), Japanese quail (*Coturnix c. japonica*), ring-necked pheasants (*Phasianus colchicus*), and mallards (*Anas platyrhynchos*).

A total of 131 compounds were tested. Toxicities are expressed as median lethal dietary concentrations (LC50) and are based on five days of dietary exposure to the test compound followed by three days of untreated feed. From these data statistical comparisons between toxicities are possible for a given species.

Certain classes of pesticides - organochlorine compounds, organophosphates and organometallic compounds - contained most of the compounds judged "highly toxic". The most frequent order of species response was bobwhite $>$ Japanese quail > ring-necked pheasant > mallard. This order correlates with their body sizes at the ages tested.

133. Holden, A.V. 1970.
INTERNATIONAL CO-OPERATIVE STUDY OF ORGANOCHLORINE PESTICIDE RESIDUES IN TERRESTRIAL AND AQUATIC WILDLIFE, 1967/68.
Pestic. Monit. J. 4(3): 117 pp.

A collaborative study of organochlorine residues in wildlife was carried out by 17 laboratories in 11 countries. The first part of the study involved the analysis of four test samples containing organochlorine residues. The second part of the program consisted of sampling and analysis of four species of wildlife from areas believed to be free of pesticide usage in each country. No specific chemicals were mentioned in the abstract.

134. Holden, A. V. 1973.
INTERNATIONAL CO-OPERATIVE STUDY OF ORGANOCHLORINE AND MERCURY RESIDUES IN WILDLIFE. 1969 - 1971.
Pestic. Monit. J. 7 (1): 37 - 52.

A two-part collaborative study study of organochlorine pesticides, polychlorinated biphenyls (PCBs) and Hg residues was done by 26 laboratories in 12 countries. The first part involved the analysis of three test samples containing organochlorine residues and one group of test sample containing Hg. One organochlorine sample contained seven pesticides or derivatives added to corn oil. A second was a standard solution of a PCB formulation in hexane: and the third a homogenate of cormorant (*Phalacrocorax carbo*) muscle containing mainly PCBs. With a few exceptions, agreement among the analysts involved was reasonably good and acceptable for monitoring wildlife residues. Coefficients of variation for the various organochlorines were from ± 10 percent to ± 17 percent. The samples were analyzed for total and methylmercury. Again, agreement was reasonably good, although only four laboratories reported total Hg values and eight methylmercury values. The second part of the program required the sampling and analysis of several species of wildlife from both terrestrial and aquatic environments, including fish, shellfish and the eggs of birds. Samples were taken in specified numbers and at specified times,from both areas considered to be free of any pesticide usage and areas known or believed to be seriously polluted. Eggshell thickness indices were also determined. The results of the wildlife analyses demonstrated the difficulties in selecting species appropriate for international monitoring programs, in identifying (before analysis) areas of high contamination and in relating concentrations to measureable biological effects. Samples of any one species from areas regarded as unpolluted in different countries contained a wide range of organochlorine concentrations. The PCB levels in mussles from such areas contained 0.01 - 0.67 mg/kg, and DDE levels in herring ranged from 0.01 to 0.30 mg/kg. The differences between residue results for samples in the second part of the study were greater than the analytical variations estimated from the first party of the study.

135. Holden, A.V., and K. Marsden. 1967.
ORGANOCHLORINCE PESTICIDES IN SEALS AND PORPOISES.
Nature 216 (5122): 1274 - 1276.

Analyses of various species of marine fish and mammals from Scottish waters during the past five years have shown that organochlorine residues are now a normal occurrence, the highest concentrations being found in organs or tissues with the highest lipid content. Thus the muscle tissue of salmonids, the livers of cod and the blubber of seals act as storage sites for these residues.

136. Hollingworth, R. M., 1971.
COMPARATIVE METABOLISM AND SELECTIVITY OR ORGANOPHOSPHATE AND CARBAMATE INSECTICIDES.
Bull. World Health Org. 44(1-2-3): 155 - 170.

The comparative metabolism and toxicity or organophosphorus and carbamate insecticides are reviewed with the purpose of assessing our present ability to design new toxicants with improved selectivity. The occurrence of quantitative and qualitative differences in metabolism in vertebrates and insects is considered and an assessment is made of the role of metabolic activation and degradation in the complex interactions governing toxicity.

137. Howell, J. L., and W. M. Wishart. 1969.
STRYCHNINE POISONING IN CANADA GEESE.
Bull. Wildl. Dis. Assoc. 5(2): 1 - 119.

Six geese from a flock of 20 that plummetted to the ground over Calgary, Alberta were examined; the gizzards contained strychnine. Possible mechanism of the poison's action is discussed.

138. Hull, A. C., Jr. 1971.
EFFECTS OF SPRAYING 2,4-D UPON ABUNDANCE OF POCKET GOPHERS IN FRANKLIN BASIN, IDAHO.
J. Range. Manage. 24(3): 230 - 232.

Four 50 x 50 foot plots were sprayed with 2 lb./acre 2,4-D in 1959, 1960, 1965 and 1969 to kill fleshy-rooted spring-growing plants and annuals. These plants are the major source of food for pocket gophers. Averaging the 10-year period, 1960 - 1969, spraying reduced gopher mounds by 93 percent and winter casts by 94 percent when compared to the unsprayed areas.

139. Hunt, L. B., and R. J. Sacho. 1969.
RESPONSE OF ROBINS TO DDT AND METHOXYCHLOR.
J. Wildl. Manage. 33(2): 336 - 345.

When exposed to methoxychlor rather than DDT, robins (*Turdus migratorius*) sustained lower mortality under both laboratory and field conditions. Comparisons of the two insecticides on captive birds involving several modes of delivery produced variable results, but it was impossible to produce methoxychlor poisoning consistently with doses as high as 3,750 mg/kg. Whenever elms were sprayed at greater than 10 lb. DDT/acre, wild robin populations apparently suffered spring mortality over 85 percent but when methoxychlor was substituted at similar rates, adult mortality in the same period was reduced to 24 percent. With DDT treatments, virtually no reproduction occurred owing mainly to adult losses but immediately after methoxychlor was first used, 17 of 22 nests on 61.2 acre study area were successful with 16 producing at least 44 fledglings. Despite the small samples, 77 percent nesting success and 2.8 young/successful nest compared favourably with prespray data. Residues of DDT, DDE, TDE, and methoxychlor were recovered from soils and at higher concentrations from three earthworm groups, but no methoxyclor was detected in bird tissues. Adult robins exposed to both DDT and methoxychlor had significantly higher DDE in both brain and breast muscle than those exposed only to DDT. Breast residues in young robins were approximately one-fourth those in adults, and death could not be definitely attributed to poisoning.

140. Hwang, S. W., and L. S. Schanker. 1974.
ABSORPTION OF CARBARYL FROM THE LUNG AND SMALL INTESTINE OF THE RAT.
Environ. Res. 7(2): 206 - 211.

The pulmonary and intestinal absorption of carbaryl was investigated by administering solutions of the compound (0.005 - 0.1mM) into the lungs or small intestine of anesthetized rats. After various times, the organs were removed and assayed for compound that remained. Percentage of the dose unabsorbed was plotted semilogarithmically against time, and absorption half-times ($t\frac{1}{2}$) were calculated from the resulting curves. Carbaryl was absorbed from the lungs ($t\frac{1}{2}$ = 2.6 min.) 2.5 times faster than from the small intestine ($t\frac{1}{2}$ = 6.4 min.). In addition, pulmonary and intestinal absorption of the insecticide appeared to occur by a nonsaturable process such as diffusion, since the amount of compound absorbed/unit time was directly proportional to the administered concentration.

141. Ingham, B., and M. A. Gallo. 1975.
EFFECT OF ASULAM IN WILDLIFE SPECIES. ACUTE TOXICITY TO BIRDS AND FISH.
Bull. Environ. Contam. Toxicol. 13(2): 194 - 199.

Asulam is relatively non-toxic to fish and wildlife species and the residue levels in fields and drainage water were several ordours of magnitude lower than the concentrations affecting the test animals. Therefore, it was concluded that asulam presents a very low potential for hazard to wildlife in treated areas.

142. Janda, J., and M. Böseova. 1968.
EFFECT OF NEW RODENTICIDES ON SMALL GAME.
Lesnicky Casopis 14(41): 115 - 124 [In Czech, Russian, French and English summaries].

No abstract could be located.

143. Jefferies, D. J. 1973.
EFFECTS OF ORGANOCHLORINE INSECTICIDES AND THEIR METABOLITES IN BREEDING BIRDS.
J. Reprod. Fert. (Suppl.) 19: 337 - 352.

A review of literature on the known effects on breeding birds, with some reference to mammals.

144. Jefferies, D. J., and B. N. K. Davis. 1968.
DYNAMICS OF DIELDRIN IN SOIL, EARTHWORMS, AND SONG THRUSHES.
J. Wildl. Manage. 32(3): 441 - 456.

An experiment to study the passage of dieldrin from soil to earthworms to song thrushes (*Turdus ericetorum*) is reported. In contrast to some food chain studies there was a decrease in ppm at each step of the chain. A content of 25 ppm in the soil resulted in a range of 18.4 to 24.9 ppm in the earthworms after 20 days exposure. After six weeks of diets ranging from 0.32 to 5.69 ppm dieldrin, thrushes showed total body residues of 0.09 to 4.03 ppm. (All results expressed in terms of wet weight.) The pharmacodynamics was studied individually in five song thrushes.

145. Jefferies, D. J., and M. C. French. 1972.
CHANGES INDUCED IN THE PIGEON THYROID BY p,p'-DDE AND DIELDRIN.
J. Wildl. Manage. 36(1): 24 - 30.

Small groups of pigeons (*Columba livia*) were fed dieldrin and p,p'-DDE, each at three dose rates for a period of 56 days. The thyroids of these birds increased in weight and showed considerable loss of colloid from the follicles associated with hyper-plastic epithelia, when compared with those of the controls. These changes are similar to those obtained by feeding p,p'DDT to pigeons and can indicate a hyper- or hypofunctioning gland. Further research with p,p'-DDT showed that pigeons were hyperthyroid at low dose rates and hypothroid at high dose rates. It is possible that the production of hypothyroidism in some wild bird species may be one of the mechanis,s responsible for thinner eggshells reported in these species. In addition to the effect on the thyroid, increased liver and adrenal weights and decreased heart weights were found in birds fed DDE. These reactions are similar to those previously reported for pigeons fed sublethal doses of DDT. The birds dosed with dieldrin, on the other hand, showed no obvious comparable changes in organ weights. The unexpected mortality in the birds fed DDE supported the suggestion that pigeons may be more sensitive to DDE than to DDT.

146. Jefferies, D. J., and M. C. French. 1976.
MERCURY, CADMIUM, ZINC, COPPER AND ORGANOCHLORINE INSECTICIDE LEVELS IN SMALL MAMMALS TRAPPED IN A WHEAT FIELD.
Environ Pollut. 10(3): 175 - 182.

A report from tests done on six long-tailed field mice (*Apodemus sylvaticus*) and one bank vole (*Clethrionomys glareolus*) trapped in a wheat field. Mercury, cadmium, zinc and copper, and organochlorines were found in the speciments in varying amounts.

147. Johnson, D. W. 1975.
ORGANOCHLORINE PESTICIDE RESIDUES IN SMALL MIGRATORY BIRDS.
Pestic. Monit. J. 9(2): 79 - 88.

This study was done on 19 species of small migratory birds killed chiefly at Florida television towers from 1964 - 1973. DDT and its derivatives were the most common chemicals located. Dieldrin was located in 60 percent of the samples.

148. Johnson, R. E., T. C. Carver, and E. H. Dustman. 1967.
RESIDUES IN FISH, WILDLIFE AND ESTUARIES.
Pestic. Monit. J. 1(1): 7 - 13.

Indicator species near the top of the food chain chosen for the study were mallard, starling, golden and bald eagles. The closely related black duck was substituted for the mallard in the states where adequate samples of mallards could not be obtained. Methods for samplings and handling the specimens are outlined. No specific pesticide names are given.

149. Johnson, L. G., R. L. Mwrris, and R. Bishop. 1971.
PESTICIDE AND MERCURY LEVELS IN MIGRATING DUCK POPULATIONS.
Bull. Environ. Contam. Toxicol. 6(6): 513 - 516.

Pesticide concentrations were lowest in the breast muscle and highest in the fat for any of the sets of composites. The mercury in the tissues had a distribution distinctly different from the chlorinated bydrocarbons, being lowest in the fat and highest in the liver. Except for two values of mercury in the liver, the samples did not show evidence of significant contamination by pesticides and mercury when evaluated against FDA tolerance for fish.

150. Joiris, C., and P. Martens. 1969.
THE LEVEL OF PESTICIDES IN RAPTOR EGGS COLLECTED IN BELGIUM IN 1969.
Aves 8 (1): 1 - 13. [In French, English summary].

A series of 15 clutches of birds of prey, totalling 29 unhatched eggs, were collected in the southern part of Belgium in 1969. Liquid-gas chromatography analysis reveals contamination of all the birds of prey by organochlorine pesticides. The sparrowhawk is an especially contaminated species. Its eggs contained up to 12 ppm of pesticides. The other species, buzzard, kestrel, tawny owl, barn owl and Tengmalm's owl were much less affected and the pesticide content of their eggs did not usually exceed 1 ppm. [No specific chemicals were mentioned in the abstract, and a copy of the study could not be located.]

151. Joiris, C., and P. Martens. 1973.
ORGANOCHLORINE PESTICIDE CONTENT IN RAPTOR EGGS COLLECTED IN BELGIUM IN 1971.
Aves 10 (3): 153 - 160 [In French, French and English summaries].

A series of 16 unhatched eggs of birds of prey were collected in Belgium in 1971 and analysed in order to determine their level of contamination with organochlorine pesticides. All the samples contained pesticide residues, the result ranging from 0.02 - 7.4 ppm total residues. As a rule, DDT and its metabolites are the most abundant contaminants. Two exceptions are Montagu's harrier (dieldrin being the most abundant in one sample) and the kestrel (BHC[Lindane] being the most abundant in the three eggs analysed). Utilizing the total DDT - content as a criterion, the most contaminated species are: sparrowhawk, long-eared owl, and partly, tawny owl (range: 2.2 - 6.9 ppm). The other eggs are much less contaminated (from 0.02 - 1.2 ppm total DDT): buzzard, honey buzzard, Montagu's harrier, kestrel, and partly, tawny owl. These differences in contamination levels are probably due to prey specificity differences between raptors (either bird - or mammal-eating raptors.)

152. Jones, D., K. Ronald, D. M. Lavigne, R. Frank, M. Holdrinet, and J. F. Uthe. 1976.
ORGANOCHLORINE AND MERCURY RESIDUES IN THE HARP SEALS (*PAGOPHILUS GROENLANDICUS*).
Sci. Total Environ. 5(2): 181 - 195.

Samples of blubber, liver, kidney, and brain were analysed for DDT, dieldrin, PCB, and total Hg. Methyl mercury levels in blood were also determined. Wide interspecific variation was noted in organochlorine and Hg residue levels. Pups taken in 1973 had lower organochlorine residues than pups taken in the same area in 1971. Preliminary investigation indicates that detectable amounts of organochlorine and Hg residues are capable of crossing the placenta in the harp seal.

153. Joy, R. M. 1976.
CONVULSIVE PROPERTIES OF CHLORINATED HYDROCARBON INSECTICIDES IN THE CAT CENTRAL NERVOUS SYSTEM.
Toxicol. Appl. Pharmacol. 35(1): 95 - 106.

Thirty-eight male cats were anesthetized and administered subgroups of chlorinated hydrocarbon insecticides. The physiological state was assessed by monitoring electroencephalogram (EEG), electrocardiogram, blood pressure, carbon dioxide and temperature. Dieldrin, endrin and lindane are rapidly acting, potent convulsants. They produce indistinquishable changes in EEG and evoked-repsonse studies. Hypersynchrony, rhythmic bursts of spikes and waves, and isolated spikes characterize the preictal state. Seizures are of a generalized tonicclonic type. Responses in sensory and motor cortex to sensory nerve stimulation are enhanced three to five fold. Aldrin and heptachlor produce similar effects but only after a delay of 20 - 30 min. and two-three times higher doses. Although it produces convulsive behavior, DDT effects are more variable. Responses to sensory nerve stimulation are usually, but not always, enhanced. Kelthane produces no measurable effects of EEG or evoked repsonse at all doses below those causing death. Dieldrin, aldrin, and lindane are directly toxic to the mammalian central nervous system and do not require metabolism to an active metabolite. For the cyclodienes, the epoxides are more potent and more rapid in development of effects than are the nonepoxide analongs.

154. Kacew, S., and R. L. Singhal. 1973.
METABOLIC ALTERATIONS AFTER CHRONIC EXPOSURE TO A CHLORDANE.
Toxicol. Appl. Pharmacol. 24(4): 539 - 544.

Daily injection of a- chlordane (5mg/kg) for 45 days significantly stimulated the activities of pyruvate carboxylase, phosphoenolpyruvate carboxykinase, fructose- 1,6-diphosphatase and glucose 6-phosphatase in liver and kidney cortex of male rats. Statistically significant increases in the quartet of the key, rate limiting gluconeogenic enzymes in two tissues were noted within 20 days when the daily amount of a- chlordane was raised to 25 mg/kg. Long term exposure to either dose of the insecticide for 45 days also elevated the concentrations of serum urea. Chronic administration of a- chlordane may be as effective as DDT in enhancing the gluconeogenic capacity of both kidney cortex and liver.

155. Kacew, S., D.J.B. Sutherland, and R.L. Singhal. 1973.
BIOCHEMICAL CHANGES FOLLOWING CHRONIC ADMINISTRATION OF HEPTACHLOR, HEPTACHLOR EPOXIDE AND ENDRIN TO MALE RATS.
Environ. Physiol. Biochem. 3(5): 221 - 229.

The influence of chronic exposure to small amounts of certain chlorinated hydrocarbon insecticides was investigated on pyruvate carboxylase, phosphoenolpyruvate carbonxykinase, fructose 1,6-diphosphatase, and glucose 6-phosphatase activities of rat liver and kidney cortex. Daily i.m. injection of heptachlor (3 and 15 mg/kg) for 45 days significantly reduced liver size without producing any consistent change in adrenal, thymus, heart, and testicular weights. Chronic treatment with either dose of heptachlor, heptachlor epoxide, and endrin produced significant stimulation in the quartet of key, rate-limiting gluconeogenic enzymes in both liver and kidney cortex; and, as expected, the degree of enhancement was greater with higher doses of organochlorine pesticides used. All of the cyclodiene insecticides were also effective in raising the concentration of blood glucose and urea and in lowering hepatic glycogen levels when given daily for 45 days. The process of glucose synthesis from noncarbohydrate precursors in both liver and kidney cortex is markedly enhanced in rats chronically exposed to either heptachlor, heptachlor epoxide or endrin.

156. Kaiser, T.O., and J. Dunham. 1972.
THE ABSORPTION OF CHLORINATED INSECTICIDES BY FROG SKIN.
Proc. Iowa Acad. Sci. 79(3 - 4): 101 - 104.

A laboratory experiment to indicate the water soluble fractions of these insecticides that are selectively absorbed by the skin. The relative quantities of insecticides absorbed appear to be partially related to their water solubilities. Lindane was the most soluble insecticide in these experiments.

157. Karapally, J.C., J.C. Saha, and Y.W. Lee. 1973.
METABOLISM OF LINDANE 14C IN THE RABBIT: ETHER SOLUBLE URINARY METABOLITES.
J. Agric. Food Chem. 21(5): 811 - 818.

About 56 percent of the urinary metabolites were soluble in ether. Identifications were made by IR spectra comparison, and by gas chromatography.

158. Kaul, R., W. Klein, and F. Korte. 1970.
CONTRIBUTIONS TO ECOLOGICAL CHEMISTRY - XX. DISTRIBUTION, ELIMINATION, AND METABOLISM OF TELODRIN AND HEPTACHLOR IN RATS AND MALE RABBITS END PRODUCT OF HOMEOTHERM METABOLISM OF HEPTACHLOR.
Tetrahedon: Int. J. Organic. Chem. 26: 331 - 337 (In German, English and German summaries)

Teledrin(I) and heptachlor (II) are slowly excreted after intravenous application, telodrin by female rats to 16 percent and by male rats to 13 percent in 48 hours. After intravenous injection male rabbits excrete 13 percent of the radioactivity within 96 hours, mainly as a hydrophilic metabolite. After intravenous administration of heptachlor, female rats excrete 32 percent, male rats 22 percent within 72 hours, whereas male rabbits excrete 23 percent of the radioactivity within 144 hours. The lower storage of telodrin and heptachlor in female rats as compared with males is opposite to excretion behaviour of all the other insecticides of this group. Telodrin is transformed to a hydrophilic metabolite, which after hydrolysis gave a known lacton (III) already reported after experiments with larvae *Aedes aegypti*. Heptachlor is transformed to an epoxide (IV) which, in turn, becomes changed to 1, 4, 5, 6, 7, 8,-heptachloro-2, 3 epoxy-3a, 4, 7, 7a tetrahydro-4, 7 endomethanoindan (VI). After administration of this hydrophilic metabolite no further transformation occurs.

159. Keith, J.A. and L.M. Reynolds. 1971.
ORGANOCHLORINE PESTICIDE RESIDUES IN TERRESTRIAL AND AQUATIC WILDLIFE: MERCURY RESIDUES IN WILDLIFE.
Can. Wildl. Serv. Pestic. Sect. Manuscript Rep. 21.

This reports gives the results of organochlorine residue analysis of three species chosen for the 1967-68 study. Samples were taken from three sites in Canada: B.C.; N.B.; and Ont.

160. Keith, J. O. 1968.
INSECTICIDE RESIDUES IN FISH-EATING BIRDS AND THEIR ENVIRONMENTS.
Aves 5(1): 21 - 41.

No abstract could be located.

161. Kenaga, E. 1969.
TORDON HERBICIDES-EVALUATION OF SAFETY TO FISH AND BIRDS.
Down Earth 25(1):* 5 - 9.

The effects of 2,4-D and other tordon chemicals on fish and birds were examined. According to this study there are no bad effects of Tordon chemicals.

162. Kenaga, E.E. 1973.
FACTORS TO BE CONSIDERED IN THE EVALUATION OF THE TOXICITY OF PESTICIDES TO BIRDS IN THEIR ENVIRONMENT.
Environ. Quality Safety 2: 166 - 181.

The most useful toxicological unit for evaluating pesticide effects on birds is the milligrams of pesticide intake per kilogram of body weight per day. Since data used for the calculation of one or two terms of this unit are often unknown, the principles necessary for estimating the amount of daily food consumption by birds, the body weight of representative species or ages of birds and the level of pesticide residues on wildlife food are summarized.

Representative data related to food consumption and body weights of different species and ages of birds are tabulated. Based on the wide range of body weights and species feeding habits, the smallest birds may consume at least ten-fold more food in terms of milligrams per kilogram of body weight per day than the largest birds. Considering also the variation of pesticide residues on different types of plants as representatives of bird food particles, the daily dietary intake of pesticide by birds (expressed as mg/kg/day) may vary at least 100-fold in environments treated with the same dosage of pesticide.

Evaluation of the toxicity of pesticides in the food of birds is most realistic if the results of subacute or chronic dietary feeding studies are available. The above information and the physical, chemical and biological properties are important factors which are related to the quantity and type of residues in the environment and to the type of toxicological tests needed to properly simulate or interpret environmental exposure of birds to pesticides under use conditions.

163. Khera, K.S., and D.A. Lyon. 1968.
CHICK AND DUCK EMBRYOS IN THE EVALUATION OF PESTICIDE TOXICITY.
Toxicol. Appl. Pharmacol. 13(1): 1 - 15.

Several embryonal ages of chicks and duck species were evaluated for toxicity quantitation by injecting into the yolk sac doses of 1 mg or less of the following pesticides: phosdrin, DDVP, ruelene, dimefox, diazinon, parathion, malathion, trithion, dimethoate, ethion, carbaryl, Bayer 37344, and Bayer 39007. Chick eggs injected in incubation days 0, 4, and 7 and duck eggs injected on days four, seven, and ten appeared to be unsuitable for toxicity studies. This was due to large variations among replications or lack of dose response relationship, or low sensitivity to the specific lethal effect. At mid-incubation of both the species (10 days in chick and 13 days in duck embryos), there was a marked mortality response occurring primarily within 24 hours of injection; in many instances another period of mortality among the survivors was manifest near the hatching. The two avian species injected at mid-incubation age are capable of providing useful data for the assessment of pesticide tocity. There was a suggesiton that duck embryos provide less variable results than chick embryos.

164. Kimmins, J.P. 1975.
REVIEW OF ECOLOGICAL EFFECTS OF HERBICIDE USAGE IN FORESTRY.
Environ. Canada Info. Rep. BC-X-139. 44 pp.

Two chapters of the report are dedicated to the effects of herbicides on wildlife. A total of 170 references are listed at the end of the two chapters. The report spans the period 1935 - 1974. The general conclusion is that direct toxic effects of herbicides are less significant than the effects produced by habitat and food plant modification. Very few wildlife species are listed throughout the paper.

165. Koeman, J. H., and H.J.A. Ensink, P. Fuchs, B.G. Hoskam, M.F. Morzer Bruijns, and R.H. deVos. 1967.
BIRD MORTALITY FROM AGRICULTRUAL PESTICIDES.
Landbouwvoorlichting. 24(11): 399 - 404 (In Dutch).

No abstract could be located.

166. Kolmodin, H. B, B. Alexanderson, and F. Sjoeqvist. 1971.
EFFECT OF EXPOSURE TO LINDANE ON DRUG METABOLISM: DECREASED HEXOBARBITAL SLEEPING TIMES AND INCREASED ANTIPYRINE DISAPPEARANCE RATE IN RATS.
Toxicol. Appl. Pharmacol. 20(3): 299 - 307.

The effect of lindane was tested in rats on hexobarbital sleeping times and elimination rate of antipyrine in the isolated perfused liver. Pretreatment with lindane shortened the hexobarbital (100 mg/kg ip) sleeping times both when given as single ip doses and in chronic feeding tests. The lowest effective doses were 15 mg/kg ip and 0.5 ppm of lindane in the food. The disappearance rate of antipyrine increased in perfused liver from rats treated four days previously with a high single dose of lindane (60 mg/kg ip). It is an increased metabolism of hexobarbital and antipyrine in the liver.

167. Konat, G. and J. Clausen. 1973.
THE CYTOCHROME P-450 COMPLEX AND ESTERASE OF THE LIVER AND BRAIN IN LINDANE. AROCLOR 1254 AND DDT-INDUCED INTOXICATION OF THE MOUSE.
Environ. Biochem. 3(3): 139 - 147.

Acute intoxication of mice was evoked by feeding a diet containing polychlorinated hydrocarbons (PCHC) followed by starvation. A significant increase in cytochrome P-450 and in the activity of mixed function oxygenase was observed in the liver of all PCHC-treated animals. The intoxication gave rise to the proliferation of liver endoplasmic reticulum as evaluated from an increase in the microsomal esterase was stimulated by aroclor 1254 and lindane treatment. Regarding the capacity of the liver to metabolize foreign compounds, aroclor 1254 was the best stimulator and DDT the weakest. The acute intoxication with DDT evoked pronounced neurological symptoms in animals.

168. Kopischke, E.D. 1972.
THE EFFECTS OF 2,4-D AND DIESEL FUEL ON EGG HATCHABILITY.
J. Wildl. Manage. 36(4): 1353 - 1356.

Three groups of 57 pheasant (*Phasianus colchicus*) eggs were each sprayed with water, 2,4-D solution, or diesal fuel to assess the effects of these liquids on hatchability. Two groups of 62 bantam chicken (*Gallus domesticus*) eggs were sprayed, one with water and one wtih 2,4-D solution. Application of 2.4-D in the concentration normally applied for weed control did not adversely affect hatchability of eggs, cause deformities in hatched chicks, or cause death of the chicks. Application of diesel fuel to pheasant eggs reduced hatchability to zero.

169. Korschgen, L. J. 1970.
SOIL - FOOD - CHAIN - PESTICIDE - WILDLIFE RELATIONSHIPS IN ALDRIN - TREATED FIELDS.
J. Wildl. Manage. 34(1): 186 - 199.

Soil - foodchain - pesticide - wildlife relationships were investigated to learn the concentration of pesticide residues present in soils, macro-invertebrates, vertebrates, and seeds as a result of annual applications of aldrin at recommended rates for pest control. Two central Missouri cornfields treated with aldrin at 1 lb/acre, for 16 and 15 of the past 17 years, were selected for study during 1965 - 67. Primary samples collected for residue analyses included soils, earth-worms (*Lumbricidae*), crickets (*Gryllidae*), and two kinds of ground beetles (*Carabidae*) obtained during early April, June, August, and October. Vertebrates and plant seeds collected during 1967 included white-footed mice (*Peromyscus maniculatus*), toads (*Bufo americanus*), snakes (*Thamnophis sirtalis* and *Pituophis sayi*) corn (*Zea mays*), foxtail (*Setaria faberii*), and annual sunflower (*Helianthus annuus*). Pesticide residues consisted primarily of dieldrin, the degradation product of aldrin.

170. Krantz, W.C., B.M. Mulhern, G.E. Bagley, A. Sprunt, IV, F.J. Ligas, and W.B. Robertson, Jr. 1970.
ORGANOCHLORINE AND HEAVY METAL RESIDUES IN BALD EAGLE EGGS.
Pestic. Monit. J. 4(3): 136 - 140.

Bald eagle eggs collected in 1968 from nests in Wisconsin, Maine, and Florida all contained residues of DDE, DDD, dieldrin, heptachlor epoxide and polychlorinated biphenyls. Many also contained traces of DDT. Eggs from five non-productive nests samples in Maine contained much higher residues than did eggs collected from either productive or nonproductive nests in Wisconsin and Florida.

171. Krapu, G.L., G.A. Swanson, and H.K. Nelson. 1973.
MERCURY RESIDUES IN PINTAILS BREEDING IN NORTH DAKOTA.
J. Wildl. Manage. 37(3): 395 - 399.

Livers of 42 pintail hens (*Anas acuta*) breeding in eastern North Dakota during the spring and early summer of 1969 and 1970 were analyzed for total mercury by the neutron activation technique. Mercury content on a wet weight basis ranged from 0.055 ppm to 9.512 ppm and averaged 0.888 ± 1.796 ppm (SD). Liver mercury levels of hens collected in early spring (prior to planting of crops) were significantly lower than those of hens taken late in the nesting season ($P < 0.01$). Mercury residues among prelaying, laying, and postlaying groups collected following the onset of spring planting did not differ significantly ($P > 0.05$). Albumen mercury residue was correlated with liver mercury content ($r = 0.756$, $P < 0.05$). Mercury content in livers of five wild juveniles averaged 0.123 ± 0.074 ppm.

172. Kreitzer, J.F. 1974.
RESIDUES OF ORGANOCHLORINE PESTICIDES, MERCURY, AND PCBs (POLYCHLORINATED BIPHENYLS) IN MOURNING DOVES FROM EASTERN UNITED STATES, 1970-71.
Pestic Monit. J. 7(3,4): 195 - 199.

Mourning dove (*Zenaidura macroura*) breast muscle samples were found to contain residues of DDT, DDE, DDD, polychlorinated biphenyls, dieldrin, mirex, mercury , and heptachlor epoxide in amounts not considered hazarouds to consumers, human or non-human. Residues of DDT plus DDE plus DDD averaged 5.83 ppm lipid weight (0.068 ppm wet weight); those of PCBs, 9.75 ppm lipid weight (0.121 ppm wet weight); compounds were found in all birds. Heptachlor epoxide and dieldrin were found in little more than trace amounts; heptachlor in all birds, dieldrin in 73. Mirex was found only in birds from South Carolina, Georgia, and Florida, averaging 4.32 ppm lipid weight (0.046 ppm wet weight) in eight birds. Less than 0.05 ppm (wet weight) mercury was found in all birds except 10, in which it ranged from 0.07 to 0.67 ppm. The 10 were from Rhode Island, Pennsylvania, Maryland, Virginia, Tennessee and Alabama.

173. Kreitzer, J.F., and G.H. Heinz. 1974.
THE EFFECT OF SUBLETHAL DOSAGES OF FIVE PESTICIDES AND A POLYCHLORIANTED BIPHENYL ON THE AVOIDANCE RESPONSE OF COTURNIX QUAIL CHICKS.
Environ. Pollut. 6(1): 21 - 29.

Corturnix coturnix were given sublethal amounts of chlordane, dieldrin, endrin, DDE, ceresan M, or aroclor 1254 in their feed, beginning at seven days of age, and their avoidance response to a moving silhouette was measured daily for 14 days. The birds were on dosage for eight days and on untreated feed for six days immediately thereafter. Group avoidance response was significantly suppressed by chlordane, dieldrin, endrin, ceresan M, and aroclor 1254. No effect of DDE on the birds behavior could be detected. The behavior of the endrin-treated birds returned to normal after two days on untreated feed. The data indicated partial recovery for birds treated with dieldrin and chlordane, but none for those treated with ceresan M or aroclor 1254. Ther percentage of controls responding to the silhouette dropped from an average of 84 for the first four days to 70 on the sixth day, then it increased daily until the end of the test when it was almost 80. This apparently aberrant behavior of healthy birds is tentatively attributed to a daily decrease in the discrepancy between the moving silhouette and the birds' schema for the silhouette, followed by maturation of the central nervous systems, beginning at about the fourteenth day of age. This maturation affected revival of interest and hence a heightened reaction to the stimulus.

174. Kreitzer, J.F. amd J.W. Spann. 1968.
MORTALITY AMONG BOBWHITES CONFINED TO A HEPTACHLOR CONTAMINATED ENVIRONMENT.
J. Wildl. Manage. 32(4): 874 - 878.

A pair of adult birds was placed in each of 32 wire-covered field pens (20 x 50 x 6.5 ft.) in May, 1962, and 36 additional pens in May, 1963. Heptachlor (technical grade on clay granules) was spread in the pens at rates of 0.125, 0.25, 1.25, and 2 lb/acre. In 1963, the treated pens were thoroughly soaked with a hose before birds were introduced to avoid the possibility of birds pecking granules. Heptachlor at 1.25 and 2 lb/acre caused severe mortality among birds introduced successively during the first 15 days after application. Mortality declined rapidly among birds placed in these same pens thereafter and was undetectable after 45 days. Mortality at 0.25 lb/acre was significant only during the first 15 days of the 1962 test. There was no detectable difference in mortality of the sexes. Water applied to the pens followed by fairly heavy rain did not significantly affect mortality.

175. Kreitzer, J.F., and J.W. Spann. 1973.
TESTS OF PESTICIDAL SYNERGISM WITH YOUNG PHEASANTS AND JAPANESE QUAIL.
Bull. Environ. Contam. Toxicol. 9(4): 250 - 256.

The present study was designed to determine the joint action of pesticides fed in pairs to Japanese quail (*Coturnix coturnix japonica*) and pheasant (*Phasianus colchicus*) chicks, and to compare the results with joint actions reported for mammals and insects. Eighteen chemicals were tested in 13 pairs. Seven of the pairs were selected because of marked synergism reported in other studies and six because of extensive, world-wide usage. The paired chemicals were: aldrin + chlordane, aroclor 1254 + DDE, chlordane + endrin, DDT + dieldrin, malathion + EPN, malathion + parathion, malathion + trichlorofon, phosphamidon + fenitrothion, guthion + trichlorofon, aroclor 1262 + malathion, DDE + ceresan M, and dieldrin + diazinon.

176. Kupfer, D. 1968.
EFFECTS OF SOME PESTICIDES AND RELATED COMPOUNDS ON STEROID FUNCTION AND METABOLISM.
Residue Rev. 19: 11 - 30.

The effects of chemicals on steroid production and metabolism. Corticoid metabolism, adrenocortical functions, androgens, estrogens and drug-metabolizing enzymes were studied.

177. Kupfer, D. 1975.
EFFECTS OF PESTICIDES AND RELATED COMPOUNDS ON STEROID METABOLISM AND FUNCTION.
CRC Crit. Rev. Toxic. 4(1): 83 - 124.

Emphasis has been placed on studies involving two types of interactions of chlorinated bydrocarbons with steroidal hormones. One interaction, which is attributed to the induction of hepatic monooxygenase by chlorinated hydrocarbons, exhibits increased rates of steroid hydroxylation; in turn, such alteration in the rate of steroid metabolism may yield potential hindrance in steroid-mediated functions. The second type of interaction appears to involve the binding of DDT derivatives, primarily o,p'-DDT, to steroid hormone receptors. In the latter interaction, the DDT derivatives appear to mimic the action of natural estrogens with respect to being able to perform various estrogen-like actions. Limited information has also been obtained on the interactions of chlorianted hydrocarbons with androgen receptors; however, by contract, this type of interaction appears to manifest antiandrogenic-like action. Such effects on steroid metabolism and function resulting from inadvertent intake of chlorinated hydrocarbons have been considered in attempting to explain reproductive problems in certain species. In birds, particularly, the thinning of eggshells can probably be attributed to exposure to environmental pollutants, such as DDT.

178. Kurtz, D. A., and C. R. Studholme. 1974

RECOVERY OF TRICHLORFON (DYLOX) AND CARBARYL (SEVIN) IN SONGBIRDS FOLLOWING SPRAYING OF FOREST FOR GYPSY MOTH.

Bull. Environ. Contam. Toxicol. 11(1): 78 - 84.

The quantity of trichlorfon and carbaryl picked up by songbirds by contact or ingestion of food materials in a sprayed area in Monroe and Pike counties in eastern Pennsylvania was studied. Baltimore orioles, crested flycatchers, and blue jay were used in the trichlorfon study. The carbaryl study used ground-feeding towhees. Trichlorfon was found in all songbirds collected after spraying, but no pesticide was found in the control birds. By species, the orioles contained more than the flycatchers, which in turn contained more than the jay. The residues were clearly within the USDA allowances, showing that the environmental impact on wildlife for this spraying should be small. No carbaryl was detected in the postspray birds. The spraying of carbaryl should have, at most, a small impact on birds at the sprayed area.

179. Lamb, D. W. 1969.

THE PHYSIOLOGICAL RELATIONSHIPS OF DIELDRIN RESIDUES IN TISSUES, EGGS AND FECES OF THE RING-NECKED PHEASANT.

Ph. D. Thesis, S. Dakota State Univ.

The researcher found dieldrin to be present in tissues two hours after the administration of 1.4 mg. Highest contents were found six hours after ingestion. Excretion of dieldrin through feces averaged 9.07 to 11.45 mg/day. 28.2 to 38 percent was excreted through a combination of feces and eggs.

180. Lamb, D. W., Y. A. Greichus, and R. L. Linder. 1970.

DISTRIBUTION OF DIELDRIN - 14C IN PHEASANT TISSUES AFTER A SINGLE ADMINISTRATION.

J. Agric. Food Chem. 18(1): 168 - 171.

The distribution and excretion of dieldrin - 14C in 48 laying hen pheasants were studied by administration of a single gelatin capsule containing 1.4 mg of dieldrin labeled with 5.5 micrograms 14C. Dieldrin residues were detected using electron capture gas chromatography and liquid scintillation counting in tissues two hours after treatment. Highest average level of residues occurred in all tissues after six hours with fat having 6.45 ppm: liver 1.56 ppm: and brain, heart, and muscle less than 0.3 ppm. Three birds appeared to absorb 86, 89 and 97 percent of the 1.4 mg of administered dieldrin. Birds killed five weeks after treatment excreted 26.5, 23.4 and 18.2 percent of the dieldrin in their feces: 11.5, 14.4 and 13.0 percent in their eggs; and 34.6, 21.2 and 32.7 percent remained in the body. Indirect evidence indicated water-soluble metabolites in the feces but not in egg yolks, while no evidence of ether-soluble metabolites was found in eggs or tissues.

181. Lamb, D.W., R. L. Linder, and Y. A. Greichus. 1967.
DIELDRIN RESIDUES IN EGGS AND FAT OF PENNED PHEASANT HENS.
J. Wildl. Manage. 31(1): 24 - 27.

Fat and egg yolks from pheasants administered different levels of dieldrin by capsule once a week for 13 weeks were analyzed for residues of the insecticide. Residues in egg yolks increased each week following treatement and decreased during a 14-day period after the final treatment, From 19 to 37 percent of the dieldrin administered was excreted via the egg yolk. At the conclusion of the experiment, the dieldrin content of the fat was higher than that of the egg yolks in all but one bird. The difference in the level of residue in fat was found to be highly significant ($P < 0.01$) between treatment groups while the levels in the egg yolks were not significantly different ($P > 0.05$) even though the average dieldrin content was greater for the higher treatment.

182. Lamont, T., and W. Reichel. 1970.
ORGANOCHLORINE PESTICIDE RESIDUES IN WHOOPING CRANES AND EVERGLADE KITES.
Auk. 87(1): 158 - 159.

Several rare birds (three whooping cranes and 3 Everglade kites), living in National Wildlife Refuges, have been analyzed to determine the amount of pesticide residues present within their bodies. The food sources (the Florida apple snail) of the Everglade kite was also analyzed in this respect. The findings in all these instances showed that the residues were low and were considered to reflect the general background contamination of the environment. However, the significance of these findings is not known.

183. Laubscher, J. A., and G. R. Dutt, and C. C. Roan. 1971.
CHLORINATED INSECTICIDE RESIDUES IN WILDLIFE AND SOIL AS A FUNCITON OF DISTANCE FROM APPLICATION.
Pestic. Monit. J. 5(3): 251 - 258.

DDT and its metabolites were studied in a diverse ecosystem downwind from an area of insecticide application. Results showed that the distance from agriculture determines the relative quantities of residues present in animals, birds, and insects. Residues of DDT plus its metabolites were detected at levels from 6 to 929 ppb in whitefooted mice and from 2.9 to 27.70 ppb in various other animals. Samples of quail liver from the study area contained residues ranging from 500 to 1,000 ppb, and soil residues ranged from 3.6 to 67,000 ppb. Results also showed that DDT residue levels in biological specimens decline as the soil insecticide concentrations decline.

184. Lawrence, C.H., R.L. Coleman, and W.L. Sowell. 1968.
ENDRIN INDUCED TRACE METAL ALTERATIONS FOLLOWING ACUTE EXPOSURE.
Bull. Environ, Contam. Toxicol. 3(4): 229 - 239.

A single oral dose of endrin (25 mg of endrin per kg of body weight) in rats produced, in two hours, (a) significant increases in the organ size parameters of the liver, kidney, brain and heart but not the spleen, (b) trace metal shifts typified as increases in the organ levels of iron, magnesium and zinc and decreases in the organ levels of copper, (c) an apparent correlation of the reactions of iron, magnesium and zinc in the kidney, spleen and heart, and (d) indications that the increase in the organ levels of magnesium and zinc occurred at the expense of the circulatory system while the same system received, at least initially, the copper mobilized away from the organ.

185. Lehner, P.N. 1973.
FAILURE OF DIELDRIN TO AFFECT COLOR VISION IN JUVENILE MALLARD DUCKS.
Arch. Environ. Cont. Toxicol. 1(4): 303 - 311.

Nine mallard ducks were raised artificially from eggs and fed the same long-term doses of dieldrin as their parents (0, 4, or 10 ppm); in addition, three ducks from 10 ppm parents were raised on 50 ppm. The parents had been on dieldrin-treated feed for two years. The juvenile ducks were tested at approximatley two months of age. Each duck was trained to respond (key peck) differentially to light wavelengths of 552 m u (S^+) and 610 m u (S^-) and, subsequently, was presented 13 different wavelengths, in random order. Differential responding was analyzed for stimulus generalization. No significant differences ($p > .05$) were found between the control and treated groups' mean stimulus generalization gradients. Only the group receiving 50 ppm in their feed had a mean whole-brain dieldrin residue significantly larger ($P < 0.05$) than that of the control group. These results indicate that the ingestion of dieldrin, under the test conditions used, does not have a measurable effect on light wavelength discrimination in mallard ducks.

186. Lehner, P.N., and A. Eghert. 1969.
DIELDRIN AND EGGSHELL THICKNESS IN DUCKS.
Nature 224: 1218 - 1219.

Results suggest: (i) dieldrin at low sublethal doses causes a statistically significant decrease in eggshell thickness in mallard ducks; (ii) both cap and lateral thickness decreases; and (iii) because of dieldrin and DDT, other chlorinated hydrocarbons may be similarly suspect in other avian species.

187. Linder, R.L., and R.B. Dahlgren. 1970.
OCCURRENCE OF ORGANOCHLORINE INSECTICIDES IN PHEASANTS OF SOUTH DAKOTA.
Pestic. Monit. J. 3(4): 227 - 232.

Residues of benzene hexachloride, lindane, dieldrin, DDT, DDE and DDD occurred among 12 to 100 adult pheasants collected in a baseline study during the winters of 1964 - 67 in the eastern half of South Dakota. DDE was most commonly found, and residue levels of all chemicals ranged from 0-8.0 ppm. Residues of dieldrin, aldrin, heptachlor epoxide, DDT, DDE, DDD, lindane, and endrin were found in adults, juveniles, or eggs collected in 1967 from study areas in Yankton and Clay Counties where past pesticide usage was highest in the State. Organochlorines occurred in fat or brain of all 48 adult birds collected, with dieldrin and aldrin occurring most frequently. Only two adults contained more than 1 ppm of any one insecticide, and detectable levels ranged from 0.01 ppm to 2.35 ppm for all residues combined. All juveniles contained residues at least one chemical, and levels were as high as 1.21 ppm for all residues combined. All except five of 70 eggs contained residues of at least one insecticide, and dieldrin and heptachlor epoxide occurred more often than other chemicals. The highest concentration of any one chemical was 1.58 ppm of dieldrin in one egg. All residues combined ranged from 0.01 ppm to 2.01 ppm for eggs.

188. Linder, R.L., R.B. Dahlgrn, and Y.A. Greichus. 1970.
RESIDUES IN THE BRAIN OF ADULT PHEASANTS GIVEN DIELDRIN.
J. Wildl. Manage. 34(4): 954 - 956.

Game farm pheasants (*Phasianus colchicus*) were individually caged and administered capsules containing 2, 4, 6, 8, 10, 12, or 110 mg dieldrin. Analysis of brain tissue of 10 hens surviving 13 weekly treatments of 2, 4, or 6 mg and killed seven days later showed 0.16 - 2.19 ppm dieldrin residue. Only 3 percent of birds dying during or after treatment had less than 2.00 ppm dieldrin in brain tissue and 8 percent had less than 3.00 ppm dieldrin. Dieldrin residues in brains averaged 5.75 among 38 birds dying during or after dieldrin administration and were not related to either dose level of total dose given. It appears that a level of 3 to 4 ppm or greater in the brain of a pheasant would indicate that death was caused by dieldrin.

189. Lockie, J.D., D.A. Ratcliffe, and R. Balharry. 1969.
BREEDING SUCCESS AND ORGANOCHLORINE RESIDUES IN GOLDEN EAGLES IN WEST SCOTLAND.
J. Appl. Ecol. -(3): 381 - 389.

The proportion of golden eagle eyries in west. Scotland successfully rearing young increased from 31 percent in the period 1963 - 65 to 69 percent in the period 1966 - 68. Concurrently, the level of dieldrin in eagles' eggs fell from 0.86 ppm

(1963 - 65) to 0.34 ppm (1966 - 68). Eagles in east Scotland, where dieldrin levels in eggs are extremely low, consistently maintained a high breeding success between 1963 and 1968. No other environmental changes are correlated with the improved success of breeding in west Scotland; in particular, the carrion food supply of eagles before and during incubation shows no parallel. It was concluded that the earlier hypothesis of Lockie and Ratcliffe (1964) was correct, namely, that contamination of dieldrin ingested with mutton carrion was the cause of a substantial decline in the breeding success of eagles in west Scotland.

190. Longcore, J.R., and B.M. Mulhern. 1973.
ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS IN BLACK DUCK EGGS FROM THE UNITED STATES AND CANADA. 1971.
Pestic. Monit. J. 7(1): 62 - 66.

Black duck (*Anas rubripes*) eggs were collected in 1971 from the northeastern United States and Canada. All 61 eggs analyzed contained DDE residues: The mean DDE residues for states and provinces ranged form 0.09 to 5.94 ppm on a wet-weight basis with mean concentrations exceeding 1.0 ppm in eggs from Maine, New York, New Jersey, and Delaware. The highest DDE concentration, 14.0 ppm, was in an egg from Delaware. DDD and DDT residues averaged less than 0.5 ppm for each collection area. No mirex residues and only trace amounts of dieldrin and heptachlor epoxide were detected. Of the 61 eggs, 57 contained PCBs. Mean organochlorine pesticide residues appeared to be lower in the 1971 samples than in those analyzed in an earlier study in 1964. The shells from the 61 eggs were measured for thickness. Comparisons of the shell thickness of eggs collected in 1971, 1964, and prior to 1940 showed that the average thickness of shells from eggs collected in 1964 was significantly less than that of shells of eggs collected prior to 1940 or in 1971.

191. Low, J.B., R.I. Lynn, R.P. Sharma, and F.A. Smith. 1974.
MERCURY AND SELECTED PESTICIDE LEVELS IN FISH AND WILDLIFE OF UTAH:
II. LEVELS OF MERCURY, DDT, DDE, DIELDRIN AND PCB IN CHUKARS, PHEASANTS AND WATERFOWL.
Bull. Environ. Contam. Toxicol. 12(2): 153 - 157.

Levels of mercury and selected pesticides were determined in muscle tissue of chukars, pheasants, and waterfowl collected from various regions within the state of Utah. None of the chukar tissue, 6 percent of the pheasant tissue and 4 percent of the waterfowl tissue analyzed contained mercury concentrations greater than the FDA limit of 0.5 ppm. None of the chukars or pheasants and only 2 percent of the waterfowl inspected contained dieldrin concentrations above the FDA tolerance level of 0.3 ppm. None of the chukars or pheasants contained levels of DDT + DDE above the 5.0 ppm FDA tolerance level. The majority of the waterfowl tissue contained levels of PCBs higher than selected pesticide levels. No definite relationship between the levels of mercury and pesticides or PCBs was noted.

192. Lutz, H., and Y. Lutz-Ostertag. 1972.
ACTION OF DIFFERENT PESTICIDES ON THE DEVELOPMENT OF BIRD EMBRYOS.
Adv. Exper. Med. Biol. 27: 127 - 150.

It appeared that pesticides tested, and presumably others, do show deleterious action on embryonic development, mainly on sexual differentiation. These results in bird embryos may well be applicable also to the mammaliam embryo, since the placenta is not a barrier for these products. Other effects including (1) paralyzed legs, distorted and contracted legs, (2) feather anomalies, and (3) thoraco-gastroschisis were noted.

193. Lutz-Ostertag, Y., and H.M. Lutz. 1970.
HARMFUL EFFECTS OF THE HERBICIDE 2,4-D ON THE EMBRYONIC DEVELOPMENT AND FERTILITY OF GAME BIRDS.
Acad. Sci. Compt. Rendus. Ser. D: Sci. Nat. 271(25): 2418 - 2421.

The experiences related in this paper point out the injurious action of the pesticides on the genital tract of different bird species. They bring about anomalies causing the sterility or at any rate a reduced fertility of the males and females. These phenomena are reflected on the second generation (2,4-D on quail and pheasant; DDT on quail). In *in vitro* cultures of medium containing certain of these pesticides, the gonadic lesions are particularly striking.

194. Lutz-Ostertag, Y., and H. Lutz. 1974.
SEXUALITY AND PESTICIDES.
Annee Biol. 13(3/4): 173 - 185.

The injurious action of the pesticides on the genital tract of different bird species are noted. Anomalies which cause the sterility or a reduced fertility of the males and females were seen. These phenomena are reflected on the second generation (2.4-D on quail and pheasant; DDT on quail). In *in vitro* cultures of medium containing certain pesticides, the gonadic lesions are particularly striking.

195. Lyons, D.B., C.H. Buckner, B.B. McLeod, and K.M. Sundaram. 1976.
THE EFFECTS OF FENITROTHION, MATACIL AND ORTHENE ON FROG LARVAE.
Environ. Canada Chem. Control Res. Inst. Rep. CC-X-129. 86 pp.

The toxicity of fenitrothion, Matacil, and Orthene to *Rana clamitans* larvae was investigated in the laboratory. The 24-h LC50 values obtained were 9.9, 247, and 6433 ppm, respectively, for these three chemicals in static bioassays with approximately 2.9 l of test solution per gram of tadpole tissue; this ratio was satisfactory for static bioassays. Mortality of larger control animals and biphasic mortality of larger Matacil-treated test animals, however, suggested that 1.7 l/g was not a sufficient volume of test medium.

In both a laboratory aquarium and an aerially sprayed pond, Orthene because of its high water solubility, was not readily absorbed and subsequently absorbed in tadpole tissue. The result was that residual levels of Orthene in tadpole tissue seldom differed from ambient levels present in the water medium. Conversely, fenitrothion is relatively lipophilic and was readily taken up by the larvae. The solubilities of these insecticides may thus affect their relative toxicity to aquatic organisms.

While fenitrothion rapidly disappeared from natural waters, at a rate approximately a negative exponential, Orthene was relatively persistent. Of the insecticides emitted from the aircraft, Orthene reached the temporary pond in a greater proportional deposit than did fenitrothion (21% and 15%, respectively). The Orthene concentration in the pond water suggested an even higher deposit than recorded from spray deposit sampling pans.

The behavioral repertoire of *Rana clamitans* tadpoles in the laboratory is discussed. The chemicals affected activity, swimming behavior, bubble-making, resting position, and color in these larvae. The possible effects of these chemicals on tadpole predators are discussed with special reference to predatory insects and mallards.

Analysis of residual levels in pond water suggested that concentrations detrimental to anuran larvae would never be encountered under normal operational applications of these chemicals.

196. Machin, A.F., H. Rogers, A.J. Cross, M.P. Quick, L.C. Howells, and N.F. Janes. 1975.
METABOLIC ASPECTS OF TOXICOLOGY OF DIAZINON: I. HEPATIC METABOLISM IN THE SHEEP, COW, PIG, GUINEA PIG, RAT, TURKEY, CHICKEN, AND DUCK.
Pestic. Sci. 6(5): 461 - 473.

The phosphorothionate insecticide diazinon was incubated with liver microsomes from the sheep, cow, pig, guinea pig, rat, turkey, chicken, and duck. Metabolism by liver slices of most of these species was also examined. Hydroxydiazinon, isohydroxydiazinon, dehydrodiazinon, their oxons, and diazixon were identified and determined quantitvely or semiquantitively. An eighth metabolite was tentatively identified as the 6 - aldehyde analogue of diazinon. Production of oxons was not generally corrleated with susceptibility to diazinon poisoning, although it was lowest in the least susceptible animals, the sheep. The degradation of oxons by liver slices was too slow to explain the low toxicity of diazinon to the mammals. In most of the mammals studied, the extra-hepatic metabolism of diazinon is more important toxicologically than metabolites in the liver. In mammalian species whose blood lacks oxonases, the liver is probably the most important site of metabolism both quantitively and toxicologically.

197. MacKenzie, C.J.G. (chairman). 1975.
ROYAL COMMISSION OF INQUIRY INTO USE OF PESTICIDES AND HERBICIDES.
Final Report of the Commissioners, May 30, 1975. (3 vol.)

Inquiry in B.C. into toxic effects of pesticides and herbicides; 12 miticides, 15 rodenticides, 12 fumigants, 67 herbicides, 76 insecticides and 31 fungicides listed. Documents fish and wildlife kills due to pesticides in B.C. Concludes little is known in field of non-lethal exposure of wildlife to pesticides. Recommendations made.

198. Martin, W.E. 1969.
ORGANOCHLORINE INSECTICIDE RESIDUES IN STARLINGS.
Pestic. Monit. J. 3(2): 102 - 114.

As part of the National Pesticide Monitoring Program, starlings (*Sturnus vulgaris*) were collected from 128 sampling sites throughout the contiguous United States. In most cases, three collections were made at each sampling site. Residue analyses for the persistent organochlorine insecticides were made at a private laboratory under contract with the Bureau of Sport Fisheries and Wildlife. DDT and its metabolites and dieldrin were found in all samples. Other residues, in order of frequency, were heptachlor epoxide, lindane, and BHC. Higher averaged residues of DDT and its metabolites and/or dieldrin were found in the southeastern United States; southern New Mexico, Arizona and California; eastern Utah; and the Willamette River drainage of Oregon.

199. Martin, W.E. 1972.
MERCURY ANDLEAD RESIDUES IN STARLINGS - 1970.
Pestic. Monit. J. 6(1): 27.

Starling (*Sturnus vulgaris*) samples from 125 randomly selected sites were analyzed for mercury residues. Except for three locations all samples had residues below 0.5 ppm. Lead residues were identical in all samples from 23 survey sites that had been tentatively selected to evaluate use of starlings as a biological measure of environmental contamination by lead. Residues of lead ranged from 0.4 to 1.33 ppm with a mean of 3.18 ppm and a standard error of 0.62 ppm.

200. Martin, W.E., and P.R. Nickerson. 1972.
ORGANOCHLORINE RESIDUES IN STARLINGS - 1970.
Pestic. Monit. J. 6(1): 33 - 40.

Starlings were collected from 125 sites in the U.S. and analyzed for persistent organochlorines. Residues of DDT and its metabolites, dieldrin, heptachlor epoxide, and benzene hexachloride were found. PCBs were also found.

201. Martin, W.E., and P.R. Nickerson. 1973.
MERCURY, LEAD, CADMIUM, AND ARSENIC RESIDUES IN STARLINGS - 1971.
Pestic. Monit. J. 7(1): 67.

Starlings (*Sturnus vulgaris*) collected in 1971 at 50 sites throughout the contiguous United States were analyzed for mercury, lead, cadmium and arsenic residues. Except for one sample containing 0.62 ppm, mercury levels were generally well below 0.5 ppm with 76 percent at 0.05 ppm or less. Lead levels ranged from 0.12 to 6.6 ppm; cadmium residues ranged from "not detected" to 0.24 ppm with 72 percent at 0.05 ppm or less; and arsenic levels were quite low with only one sample (0.21 ppm) exceeding 0.05 ppm.

202. McCaskey, T.A., A.R. Stenp, B.J. Liska, and W.J. Stadelman. 1968.
RESIDUES IN EGG YOLKS AND RAW AND COOKED TISSUES FROM LAYING HENS ADMINISTERED SELECTED CHLORINATED HYDROCARBON INSECTICIDES.
Poultry Sci. 47: 564 - 569.

Leghorn laying hens were administered 10 - 15 ppm of ovex, methoxychlor, chlordane, telodrin, or kelthane, calculated from weight of their average daily feed consumption, in gelatin capsules for five consecutive days. Eggs were collected from the hens and the insecticide contents of the yolks were determined. The insecitcide content of the abdominal fat and white and dark chicken meat from each hen was determined after cooking for three hours at 121°C.

The insecticides were found in the abdominal fat of the hens in significant amounts. Kelthane was recovered in largest amount and methoxychlor in smallest amount. The amounts of insecticide residues in the rendered fat samples were in the same relative concentrations as the amounts in raw abdominal fat.

The insecticide content of raw dark meat was higher than that found in raw white meat. After cooking, the proportion of insecticide was still greater in the dark meat. Methoxychlor was not recovered from raw or cooked chicken tissues in excess of 0.1 ppm. Telodrin was recovered from raw tissue but not from cooked tissue. Ovex, chlordane and telodrin were distributed about equally in the fat of raw white and dark meat while kethane was distributed more in the fat of raw dark meat. Cooking did not greatly affect the content of ovex or kelthane in the fat of white or dark tissue. The cooking process reduced the telodrin and chlordane contents of the chicken tissues.

Insecticides were found in the yolks of eggs collected from hens administered insecticides. Kelthane accumulated more in the yolks than the other insecticdes studies and methoxychlor accumulated the least.

203. McCollister, D.D. and M.L. Leng. 1969.
TOXICOLOGY OF PICLORAM AND SAFETY EVALUATION OF TORDON HERBICIDES.
Down Earth 25(2): 5 - 10.

Use of the herbicide 4-amino-3, 5, 6-trichloropicolinic acid (picloram) presents no problem regarding safety to humans, livestock, or wildlife. The acute oral toxicity is low in both small and large animals, with LD_{50} values of 2,000 and 8,000 mg/kg in rabbits and rats, respectively. No adverse effect was observed in rats fed diets containing 1,000 ppm for 90 days, and only minimal effects were produced at 10,000 ppm (1 percent of the total diet). A no-effect level of at least 150 mg/kg/day was obtained in 2-year feedings studies in rats and dogs. Its toxicity is also very low for birds, fishes and other aquatic organisms. Treatment of rangeland or of fields of small grain with effective dosages of Tordon herbicides would not produce toxic residues in feeds for animals, nor in foods to be consumed by humans.

204. McEwen, L. C., C. E. Knittle, and M. L. Richmond. 1972.
WILDLIFE EFFECTS FROM GRASSHOPPER INSECTICIDES SPRAYED ON SHORT-GRASS RANGE.
J. Range Manage. 25(3): 188 - 194.

Insecticides were sprayed experimentally at several sites on short-grass plains vegetation to determine effectiveness for grasshopper (*Acrididae*) control. Effects of the applications on resident wildlife were studied by the Denver Wildlife Research Centre. Observations were also made on the effects of an operational range caterpillar (*Hemileuca oliviae*) control program with toxaphene. Direct effects on birds varied widely with the chemicals applied, spray rates, and conditions. Application (in ounces of active ingredient per acre) that killed birds and resulted in significant population decreases were: fenitrothion (9.6 oz.), BAY 77488 (4.6 and 9.3 oz), diazinon (5.0 to 8.0 oz.), and toxaphene (16 oz.). Applications that resulted in significant population decreases under some conditions, but without any observed bird mortality, were fenitrothion (6.3 oz.), baygon (3.0 - 4.0 oz.), and guthion (4.0 oz.) Applications without observed direct effects on wildlife were BAY 77488 (2.5 oz.), carbaryl (6.4 oz.), malathion (6.8 oz.), and mobam (3.0 oz.). Registrations and use of pesticides for range grasshopper control should be limited to those that degrade rapidly in the environment, have the least direct impacts on wildlife, and have been thoroughly field-tested.

205. McEwen, L.C., R. K. Tucker, J.O. Ellis, and M.A. Haegele. 1973.
MERCURY-WILDLIFE STUDIES BY THE DENVER WILDLIFE RESEARCH CENTRE. 1973.
PAGES 146-156 in D. R. BUHLER ED. 1973. MERCURY IN THE WESTERN ENVIRONMENT.
Oregon State University Press, Corvallis. 360 pp.

Several studies have been undertaken to determine mercury-wildlife effects and relationships. These studies have included investigations of: (1) the acute oral toxicity of some common mercury-containing fungicides to mallard ducks and other captive birds; (2) mercury residues in tissues of gray partridges fed wheat treated with ceresan L, (3) effects of daily ceresan M doses on pheasant reproduction and of single doses of ceresan M to mallard and coturnix quail on eggshell thickness; and (4) acute oral toxicity of ceresan M, to wild pheasants in a natural habitat.

206. McGrath, C.A. 1969.
THE USE OF PESTICIDES IN MANITOBA AND THEIR EFFECTS ON WILDLIFE.
Man. Dept. Mines Nat. Resour. 20 pp. mimeo.

This paper broadly discusses pesticide use in Manitoba citing many cases where pesticides have been blamed for destruction of wildlife in Manitoba. It is mainly concerned with the organochlorines. Chemicals used on environmental control projects (such as mosquito abatement) are noted.

207. McLane, M. A. R., L. F. Stickel, E. R. Clark, and D. L. Hughes. 1973.
ORGANOCHLORINE RESIDUES IN WOODCOCK WINGS, 11 STATES - 1970-71.
Pestic. Monit. J. 7(2): 100 - 103.

A survey of organochlorine residues in woodcock wings was undertaken to determine whether these wings are suitable for showing regional differences in residues and to obtain a baseline in 1970-71 for later comparisons. Woodcock wings were obtained from the annual hunter's wing survey. Samples came from eight eastern states and one tri-state (North Carolina, South Carolina, and Georgia). Wings from the tri-state area contained significantly higher concentrations of DDT (including DDT, DDD, and DDE) than those from other states. Concentrations of PCBs were significantly higher in samples from these three states. Wings from Louisiana and the tri-state area had significantly higher concentrations of dieldrin than wings from the other states, and those from Louisiana had signficantly higher concentrations of mirex than those from other states. The compounds detected and the ranges of residue means for all sampling areas were as follows: total DDT, 5.89-6.515 ppm; DDT, 0.34-14.93 ppm; DDE, DDE, 4.66-47.47 ppm; DDD 0.11-3.44 ppm; mirex 0.76-16.93 ppm; dieldrin, 0.09-3.06 ppm; and PCBs, 4.27-8.63 ppm. Woodcock wings appear to be suitable for determining regional differences in organochlorine residues in this species.

208. Menzie, C. M. 1972.
EFFECTS OF PESTICIDES ON FISH AND WILDLIFE. PAGES 482-500 in Matsumura, F., G. M. Boush and T. M. Isato eds. ENVIRONMENTAL TOXICOLOGY OF PESTICIDES.
Academic Press, New York. 637 pp.

An overview of the toxic effects of pesticides on mammals, birds and fish citing specific examples of environmental contamination by various chemicals. Organochlorines are the most serious threat due to persistence and biological magnification. Sub-lethal and longlasting effects are difficult to assess. Effects in mammals are difficult to assess due to lack of definite data. Many effects on birds and fish are well documented and illustrated. (32 references).

209. Messick, J.P. 1972.
ORGANICHLORINE [sic] RESIDUES IN WILD RING-NECKED PHEASANTS FROM SOUTHERN IDAHO.
Bull. Environ. Contam. Toxicol. 8(6): 356 - 360.

Organochlorine residues were surveyed in pheasants, pheasant eggs, associated soils, and food plants in southwestern Idaho. DDT, DDE, and dieldrin predominated among the organochlorine residues found in pheasants and pheasant eggs. Some adipose and egg samples contained trace amounts of BHC, lindane, heptachlor, heptachlor epoxide, aldrin and endrin. Except for one liver and one egg, all samples contained residues. Eggs collected from the same nest sometimes contained different pesticides and widely divergent amounts of the same pesticides. Twelve eggs from a single nest on a farm where pesticide use was heavy had a range for all organochlorines combined of 0.57 to 63.14 ppm with a mean of 0.80 ppm. Since amounts of residues correlate with the intensity of pesticide use, sportsmen can minimize the intake of pesticides by consuming pheasants from areas of no pesticide use.

210. Mills, J. A. 1973.
SOME OBSERVATIONS ON THE EFFECTS OF FIELD APPLICATIONS OF FENSULFOTHION AND PARATHION ON BIRD AND MAMMAL POPULATIONS.
New Zeal. Ecol. Soc. Proc. 20: 65 - 71.

The application of fensulfothion and parathion for the control of invertebrate pasture pests in Canterbury, New Zealand during March, April and May 1970 killed many birds and mammals. Two hundred and thirty-six dead birds were found after a single application of fensulfothion to 123.4 ha, and 158 birds were recovered from 78.5 ha of pasture treated with parathion. The main species killed were white-backed magpie (*Gymnorhina tibicen*), black-backed gull (*Larus dominicanus*) and harrier hawk (*Circus approximans*). Field trials of fensulfothion on 72.8 ha of pasture at Rotorua reduced the bird population using the treated areas by 86 percent within two days of treatment. Most deaths probably occurred through secondary poisoning, although the possibility of primary poisoning through contact or the ingestion of the insecticide granules cannot be discounted.

211. Moats, William A. 1970.
TOWARD SAFER USE OF PESTICIDES.
Bio. Sci. 20(8): 459 - 464.

A brief paper, which is a gathering of other studies. It explains the general effects of pesticides on fish and wildlife and lists the pros and cons along with some suggestions.

212. Moore, G. L. 1968.
CHLORINATED HYDROCARBON RESIDUES IN PRONGHORN ANTELOPE, (*ANTILOCAPRA AMERICANA*)(ORD) OF SOUTH DAKOTA COLLECTED IN 1966.
M. S. Thesis, S. Dak. State Univ.

No abstract located.

213. Moore, C. L., Y. A. Greichus, and E. J. Huggins. 1968.
INSECTICIDE RESIDUES IN PRONGHORN ANTELOPE OF SOUTH DAKOTA.
Bull. Environ. Contam. and Toxic. 3(5): 269 - 273.

The average amount of the combined chlorinated insecticides per animal was 0.08 ppm in 1966. Proghorn antelopes analyzed in 1964 contained the same average amount. It appears that in the limited number of pronghorn antelope sampled, there has been no change in the total amount of chlorinated insecticides present from 1964 to 1966. However, five animals had from 0.02 to 0.08 ppm of dieldrin, whereas dieldrin was not found above 0.03 ppm in any of the animals in the 1966 study. This may reflect the federal government's restriction on the use of dieldrin.

214. Moore, M. 1972.
PESTICIDES AND PREDATORY BIRDS.
South Dakota Bird Notes 24(3): 62 - 63.

No abstract located.

215. Morris, J. E. 1973.
EFFECTS OF DIELDRIN ON REPRODUCTION IN RACOONS.
Ph. D. Thesis. U. of Missouri. 112 pp.

The effects of dietary dieldrin on the fertility and fecundity of captive raccoons were studied from September, 1968 through June, 1970. Raccoons were fed a control or a 2 ppm dieldrin treated diet. Experimental groups on each of the diets consisted of 10 juvenile males, 10 juvenile females and 10 adult females.

Young male raccoons on the dieldrin treated diet showed delayed sexual maturation and lower fertility. During the seventh month, active spermatogenesis was apparent in five of 10 control males but in only one of 10 treated males. The percentage of viable sperm was significantly higher in control (72.9 percent) than treated males (51.3 percent). The mean dieldrin load in thigh muscle was 0.8 ppm after 21 months on the dieldrin diet.

Treated females exhibited abnormal estrous cycles, reduced ovulation rates, increased resorption of embryos and higher adult mortality. Eight of 20 females died after the eighteenth month on the experimental diet. Dead embryos and uteri from treated females that had a normal estrous cycle had higher dieldrin residues than those females which did not have a normal estrous cycle. Both uteri and embryos accumulated dieldrin.

216. Morris, R. D. 1969.
EFFECTS OF ENDRIN ON SMALL MAMMAL POPULATIONS.
Ph. D. Thesis. Univ. Saskatchewan. 274 pp.

Microtus numbers in the experimental enclosure decreased by 48.7 percent immeidately after endrin application. Recovery in numbers during post-spray trapping periods was by recruitment of juveniles born in the enclosures. By the last trapping period, *Microtus* numbers were higher in the experimental enclosure than in the control enclosure. Whereas numbers in the *Peromysus* control population fluctuated but remained relatively high throughout the study, numbers in the experimental population were reduced to very low levels after spray in 1966 and never did recover.

217. Morris, R. D. 1970.
THE EFFECTS OF ENDRIN ON *MICROTUS* AND *PEROMYSCUS*. I. UNENCLOSED FIELD POPULATIONS.
Can. J. Zool. 48: 695 - 708.

Effects of endrin on unenclosed field populations of *Microtus pennsylvania* and *Peromyscus maniculatus* were investigated from June 1966 to October 1968. Adjacent seven acre control and experimental plots were live-trapped each summer at regular intervals before and after a single endrin application of 8.0 oz. per acre to the experimental plot.

Immediate and significant postspray declines in *Microtus* occurred on the experimental plot but no long-term toxicological effect was demonstrated. The experimental *Microtus* population rapidly recovered in numbers, eventually exceeded prespray numbers in two years, and exceeded corresponding control numbers in all three years. In 1966 and 1968, significantly more new *Microtus* were captured during postspray trapping on the experimental than on the control plot, and recruits survived significantly better than new individuals entering the more stable control population.

It is suggested that reduction in numbers and the presumed decrease in intraspecific aggressive encounters disrupted the social structure to such an extent that normal regulation of numbers was no longer possible. The experimental *Microtus* population appears to have responded to endrin as it would to a local depopulation by removal trapping.

Although *Peromyscus* were more abundant on the experimental than on the control plot before the first endrin application, their numbers were significantly reduced after spray in 1966 and never did recover. Recruitment by immigration or breeding did not occur and all individuals captured on the experimental plot in 1967 and 1968 remained there for only one trapping period. A long-term toxicological effect on *Peromyscus* was demonstrated, indicating a differential response of the two small mammal species to endrin.

218. Mulhern, B. M., and J. R. Longcore. 1973.
ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS IN BLACK DUCK EGGS FROM THE UNITED STATES AND CANADA - 1971.
Pestic. Monit. J. 7(1): 62 - 66.

Black duck (*Anas rubripes*) eggs were collected in 1971 from the Northeastern

United States and Canada. All 61 eggs analyzed contained DDE residues: the mean DDE residues for states and provinces ranged from 0.09 to 5.94 ppm on a wet-weight basis, with mean concentration exceeding 1.0 ppm in eggs from Maine, New York, New Jersey and Delaware. The highest DDE concentration, 14.0 ppm, was in an egg from Delaware. DDD and DDT residues averaged <0.5 ppm for each collection area. No mirex residues and only trace amounts of dieldrin and heptachlor epoxide were detected. Of the 61 eggs, 57 contained PCBs: mean PCB residues ranged from <0.05 ppm in samples from Nova Scotia to 3.30 ppm in those from Massachusetts, with trace amounts occurring in nearly half the samples. Mean organochlorine pesticide residues appeared to be lower in the 1971 samples than in those analyzed in an earlier study in 1964.

The shells from the 61 eggs were measured for thickness. Comparisons of the shell thickness of eggs collected in 1971, 1964 and prior to 1940 showed that the average thickness of shells from eggs collected in 1964 (0.321 mm) was significantly less ($P < 0.01$) than that of shells of eggs collected prior to 1940 (0.348 mm) or in 1971 (0.343 mm).

219. Mulhern, B. M., W. L. Reichel, L. N. Locke, T. G. Lamont, A. Belisle, E. Cromartie, G. E. Bagley, and R. M. Prouty. 1970.
ORGANOCHLORINE RESIDUES AND AUTOPSY DATA FROM BALD EAGLES 1966-68.
Pestic. Monit. J. 4(3): 141.

Sixty-nine bald eagles found moribund or dead in 25 states during 1966-69 were analyzed for pesticide residues. Residues of PCB and DDE were detected in all samples of eagle carcasses; residues of dieldrin were detected in 68 and residues of DDD in 64; DDT, heptachlor epoxide, and DCBP were detected less frequently. Eight specimens had levels of dieldrin in the brain within the lethal range, and another probably died of DDT poisoning. Autopsy revealed that illegal shooting was the most frequent cause of mortality of these eagles; electrocution, impact with vehicles, probable lead poisoning, and infectious avian diseases were other causes of mortality.

220. Munro, D. A. and V. A. F. Solman. 1968.
IMPACT OF WATER POLLUTION ON WILDLIFE. Pages 131-138 in A. deVos (ed
Pollution Reader. Harvest House, Montreal. 246 pp.

This report takes a brief look at the impact of water pollution on wildlife. In this paper, pollution is considered to be the addition by man of materials that alter qualitatively or quantitatively the natural load of materials suspended or dissolved in water. Differing kinds of pollutants and differing quantities will have varying effects. While certain pollutants are not poisonous, they may be sufficiently damaging to cause death. The example of oil is cited. Any alteration which upsets the original dynamic balance of an ecological community may have unexpected and unwanted after-effects.

221. Murphy, D. A., and L. J. Korschgen. 1970.
REPRODUCTION, GROWTH, AND TISSUE RESIDUES OF DEER FED DIELDRIN.
J. Wildl. Manage. 34(4): 887 - 903.

Feeding tests were conducted from January, 1966, to January, 1969, to ascertain the effects of daily ingestions of sublethal amounts of dieldrin on white-tailed deer (*Odocoileus virginianus*). Groups of deer on 0 ppm dieldrin (controls), 5 ppm, and 25 ppm dieldrin were maintained at these respective levels, as were their progeny. Treated food was readily accepted. Dieldrin intoxication was not observed, and nine of 10 animals of each group survived three years of treatment. No differences in conception or in utero mortality were found between groups. Fawns from dieldrin fed does were smaller at birth and greater post-partum mortality occurred. Fertility of male progeny was not affected. Growth was slower and remained reduced in dieldrin-treated females which were immature when the study began. Hematologic values and serum protein concentrations were not significantly ($P > 0.05$) related to treatment. Liver/body weight ratios were significantly ($P < 0.05$) larger for the 25-ppm-dieldrin group. Pituitary glands were smaller and thyroids were larger in dieldrin-fed deer. Weight gains of fawns were significantly ($P < 0.05$) reduced two of three years in dieldrin-treated groups. Placental transfer of dieldrin occurred. Whole milk from does fed 25 ppm dieldrin contained residues of 17 ppm. Residue levels in brain, liver, and thigh muscle tissues showed no evidence of increasing with length of treatment, but showed definite relationships to levels of dieldrin in daily diets. Nursing fawns had higher residues in brain tissues than did older deer on 5 ppm and 25 ppm dieldrin. Highest brain residues (12.60 and 12.10 ppm, wet weight) occurred in fawns only a few days of age at death. Equilibrium between ingestion and storage or excretion of dieldrin occurred prior to 200 days and continued until nearly 1,100 days. There was no evidence of a sharp decline in residues after a long period of continued dosage. Daily ingestion of 100 and 200 ppm of dieldrin proved fatal to yearling male deer at 27 and 22 days, respectively.

222. National Research Council of Canada. 1972.
PICLORAM: THE EFFECTS OF ITS USE AS A HERBICIDE ON ENVIRONMENTAL QUALITY.
NRCC Publ. 13684. 128 pp.

A summary and interpretation of the extensive published data now available on picloram for use of those concerned with its environmental evaluation. It may also be of interest to those considering new or expanded uses of the chemical.

The report says very little about effects to mammals. "It may be generally concluded from the available toxiological data that the use of picloram presents no hazard to humans, livestock and wildlife."

Some laboratory studies with rats, beagle dog, sheep, swine, cows, Japanese and bobwhite quail, mallard, pheasants, chickens, rabbits, mice. Some effects were harmful but mostly picloram proved non-lethal.

223. National Research Council of Canada. 1975.
ENDOSULFAN: ITS EFFECTS ON ENVIRONMENTAL QUALITY.
NRCC Publ. 14098. 98 pp.

To assist those involved in the evaluation of the impact of endosulfan on Canadian ecosystems, a critical review of the available information on this compound is presented. When endosulfan is incorporated in the soil, one of its two isomeric forms, α endosulfan, disappears readily, but the other isomer, β endosulfan, is very persistent, with 50 percent remaining in the soil two years after application. The principal degradation product in the soil is endosulfan sulfate, which is nearly as toxic and persistent as the parent compound. Little contamination of ground water was indicated. Waters from agricultural regions do contain detectable residues but indications are that they should readily degrade in "healthy waters" to less toxic products. In aquatic ecosystems, laboratory studies indicate that marine organisms, especially fish, are highly sensitive to concentrations of a few micrograms/liter for even short periods of exposure. Data are not sufficient for an evaluation of the effect of endosulfan or its sulfate on bottom-dwelling organisms. The accumulation pattern of endosulfan in terrestrial food chains is generally similar to that of aquatic ecosystems. Studies indicate that in mammals acute effects occur in the 50-243 mg/kg body weight range. No effect on reproduction has been indicated in studies to date, although juvenile birds appear to be more sensitive than adults.

224. National Research Council of Canada. 1975.
FENITROTHION: THE EFFECTS OF ITS USE ON ENVIRONMENTAL QUALITY AND ITS CHEMISTRY.
NRCC Publ. 14103. 162 pp.

Recommendations are presented which will allow an assessment to be made of the long-term effects of the organophosphorus insecticide on the avian, insect, and aquatic vertebrate populations of eastern Canadian forests. Fenitrothion is applied aerially each year at the rate of 2-4 oz/acre to control the spruce budworm. The recommendations suggest that laboratory studies be conducted under well-defined, environmentally relevant conditions, and that in any pest control program the exact composition of the pesticide should be established. Exposure should be expressed in terms of the measured quantity reaching the target, a better picture of actual distribution and terminal residues of the pesticide should be determined, and attention should be given to the partitioning and detection of fenitrothion in aquatic sediments. Studies should be initiated on bird and bee populations, and sublethal effect studies should be made to provide a handle for the assessment of the risks associated with the field application of this material. Appropriate studies should be initiated to define the important exposure routes to birds, and water bioassays should be conducted with aquatic insect larvae as a means of determining the relative risks of new insecticides. Since some invertebrates accumulate significant quantities of fenitrothion, studies should be initiated on their use as possible indicators.

225. National Research Council of Canada. 1975.
METHOXYCHLOR: ITS EFFECTS ON ENVIRONMENTAL QUALITY.
NRCC Publ. 14102.

Methoxychlor has been extensively used in the control of mosquitoes and blackflies since the ban on DDT. Toxicological data and the effects on laboratory animals are presented.

226. National Research Council of Canada. Undated.
CHLORDANE: ITS EFFECTS ON THE CANADIAN ECOSYSTEM AND ITS CHEMISTRY.
NRCC Publ. 14094. 289 pp.

A summary of the data now available to be used in the evaluation of the environmental impact of present, expanded, and new uses of this insecticide in Canada.

The report does not study the effect of chlordane on vertebrate animals. It simply states that because chlordane is quite readily degraded in homeotherms, it would not readily be accumualted by them.

227. Nelson, J.R., L.E. Wookey, C. F. Nockels, and J. V. Shutze. 1972.
INTERACTION OF VITAMIN A AND DIELDRIN ON MALLARD LIVER LIPIDS AND BIOTIN CONTENT.
Poultry Sci. 51(3): 747 - 751.

The effect of chronic ingestion of a low level of dieldrin (1 mg kg body weight) was studied on mallards fed a diet either adequate or deficient in vitamin A. No gross symptoms of dieldrin toxicity were observed after 12 weeks on experimental diets. After 5 weeks, marked foot pad keratinization occurred in pesticide-fed ducks. Vitamin A deficient birds had significantly reduced liver weight when compared to the other treatment ducks. There was no effect of feeding pesticide on vitamin A content of the liver, but biotin per gram of liver was significantly ($P < 0.05$) lower in the pesticide-fed ducks than in the nonpesticide-fed birds. Liver fatty acid composition was latered either by pesticide ingestion or vitamin A deficiency. There were significant ($P < 0.05$) accumulations of stearic and palmitic acids with a comparable reduction of the monoenoic derivatives in the dieldrin-fed ducks when vitamin A was adequate in the diet. There were higher levels of long chain polyunsaturated fatty acids (18:2, 18:3 and 20:4) in the dieldrin-fed birds when vitamin A was deficient. Ingestion of dieldrin at this level had a marked depressant effect on liver biotin content and altered fatty acid composition possibly by interference in enzyme systems involved in lipid metabolism.

228. Newton, I. 1973.
SUCCESS OF SPARROWHAWKS IN AN AREA OF PESTICIDE USAGE.
Bird Study. 20(1): 1 - 8.

In 1971, only a fifth of 113 hen sparrowhawks in a 500 km^2 study area in southern Scotland hatched all their eggs successfully, two-fifths lost at least one egg, another fifth lost all their eggs, and the remaining fifth failed to lay. Besides non-breeding, the main cause of failure were thin egg-shells, egg-breakage, and embryonic deaths. These factors together reduced the potential output of young in the population by 56 percent, and other factors (including direct human intervention) by another 5 percent. On their present scale, the important factors have all been attributed by various authors to the presence in the birds of sublethal levels of certain pesticides. Substantial organo-chlorine residues were found in all ten eggs from the study area that were analyzed. Egg-shells collected in 1971 weighed 17 percent less than shells collected in the same general area in 1900-1940, yet no parallel reduction in the size of shells had taken place. In the study area, the proportion of occupied sparrowhawk sites increased between 1967 and 1971, but the proportion of pairs producing young, and the mean brood size in successful nests, remained consistently low.

229. Newton, I. 1974.
CHANGES ATTRIBUTED TO PESTICIDES IN THE NESTING SUCCESS OF THE SPARROWHAWK IN BRITAIN.
J. Appl. Ecol. 11(1): 95 - 102.

This paper compares the nesting success of the species before and during the time when these pesticides were in widespread use. It also compares nesting success since 1956 on two land types, each subjected to a different level of pesticide application. For this last purpose, breeding records have been examined according to whether they were obtained within an arbitrary distance (20 km) from arable land or farther away, on untilled areas used mainly for sheep, deer, grouse or forestry, in the north and west of Britain.

230. Nickerson, B.R., and K.R. Barbehenn. 1975.
ORGANOCHLORINE RESIDUES IN STARLINGS, 1972.
Pestic. Monit. J. 8(4): 247 - 254.

During the fall of 1972, starlings were collected from 130 sites in conjunction with the National Pesticide Monitoring Program. They were analyzed for DDT and its metabolites, dieldrin, heptachlor epoxide, benzene hexachloride, polychlorinated biphenyls, and for the first time in the series, exychlordane and HCB. Mean DDT and dieldrin residue levels have declined significantly since 1967 and a regression analysis suggests that levels of DDT and its metabolites should fall below a mean of 0.1 ppm for the 1974 starling collection.

231. Nusz, W.A., R.J. Robel, A.D. Dayton, and T.L. Hopkins. 1976.
RESIDUE LEVELS AND WEIGHTS OF BOBWHITES GIVEN DIELDRIN.
J. Wildl. Manage. 40(1): 111 - 117.

Adult male bobwhites (*Colinus virginianus*) were given crop injections of dieldrin dissolved in corn oil and sacrificed periodically so that residue accumulations in brain and body tissues could be determined. Dieldrin dosages were similar to estimated dosages obtained by birds on treated agricultural field under natural conditions. Birds receiving 6.25 or 12.50 ug every four days for 66 days accumulated about 0.1 ppm of dieldrin residue in their body and 0.2 ppm in their brain. Quail dosed with 50 and 100 ug of dieldrin every two days for 70 days accumulated about 1.2 ppm of dieldrin residue in their body and 1.3 ppm in their brain. The highest dieldrin residue level found in the body (2.5 ppm) of a sublethally dosed bird was in a bird dosed with 100 ug of dieldrin for 40 days, and the highest brain concentration (4.0 ppm) was in a bird dosed with 100 ug of dieldrin for 60 days. Quail given dieldrin at all dose levels gained less weight than control. The LD_{50} for treated birds was between 200 and 400 ug/day (1.2 and 2.4 mg/kg/day).

232. Oden, T. 1971.
THE EFFECTS OF PESTICIDES ON BIRDS.
Bitki Koruma Bulteni 11(4): 247 - 270 [In Turkish,English Summary].

Literature on the effects of pesticides on birds were reviewed and the realtionship between the use of pesticides and their effects on bird populations in Turkey was given.

It is celarly understood that population of skylark (*Alauda arvensis*), sparrowhawk (*Accipiter nisus*), kestrel (*Falco tinnunculus*), peregrine (*Falco peregrinus*), common buzzard (*Buteo buteo*), kite (*Milvus sp.*), hoopoe (*Upupa epops*) were affected by the use of pesticides in Turkey. Many dead birds of these species were found in the fields treated with different kind of pesticides.

233. Offner, H., G. Konat, and J. Clausen. 1973.
THE EFFECT OF DDT, LINDANE AND AROCLOR 1254 ON BRAIN CELL STRUCTURE.
Environ. Physiol. Biochem. 3(4): 204 - 211.

The effect of DDT, lindane, and aroclor 1254 on rat brain cell culture was investigated. The most toxic was DDT, which caused destruction of all cells within four days after its administration, and the least toxic was aroclor 1254. Generally, administration of these compounds caused destruction of the cell processes with vacuolization and swelling of the cell body.

234. Payne, N.B., G.R. Herzberg, and J.L. Howland. 1973.
INFLUENCE OF SOME INSECTICIDES ON THE ATP-ASE OF MOUSE LIVER MITOCHONDRIA.
Bull. Environ. Contam. Toxicol. 10(6): 365 - 367.

Mitochondrial energy coupling is localized in the inner mitochondrial membrane, and coupling is highly sensitive to assault on the integrity of that membrane. Mouse liver mitochondria were isolated, and the action of insecticides on processes associated with mitochondrial energy conservation is examined. Low concentrations of several chemically unrelated insecticides stimulate mouse mitochondrial ATPase in a manner similar to that of uncouplers of oxidative ATP synthesis. Such uncoupling would be expected to lead to disruption of cellular energy supply and to contribute to the toxicity of the compounds. Aldrin, allethrin and DDT were used in the experiments.

235. Peakall, D.B. 1967.
PESTICIDE-INDUCED BREAKDOWN OF STEROIDS IN BIRDS.
Nature 216(5114): 505 - 507.

Birds were used in this work and the possibility of additive or synergistic effects of DDT and dieldrin was examined. The experiments demonstrate that relatively small amounts of DDT and dieldrin can induce increased rates of metabolism of steroids by induction of hepatic enzymes.

236. Peakall, D.B. 1970.
PESTICIDES AND THE REPRODUCTION OF BIRDS.
Sci. Am. 222(4): 72 - 78.

A general review of the reproductive failures and declining populations of several species of raptors due to the effects of hydrocarbons.

237. Peakall, D.B. 1975.
PHYSIOLOGICAL EFFECTS OF CHLORINATED HYDROCARBONS ON AVIAN SPECIES. Pages 343-360 in
R. Hague and V. H. Freed, eds. ENVIRONMENTAL DYNAMICS OF PESTICIDES.
Environ. Sci. Res. Ser. 6. Plenum Press, New York.

A general paper on the effects of organochlorine insecticides on birds. DDT is the most frequently mentioned chemical.

238. Peakall, D.B., and J.L. Lincer. 1972.
METHYL MERCURY: ITS EFFECT ON EGGSHELL THICKNESS.
Bull. Environ. Contam. Toxicol. 8(2): 89 - 90.

Effects of mono- and di-methyl mercury on the shell thickness of ring dove (*Streptopelia risoria*) and American kestrel (*Falco sparverius*) eggs were studied. Two clutches (two eggs each) were collected from each pair of doves before the administration of mercury. The volatile dimethyl mercury was given by i.m. injection (10 mg/kg dissolved in semane oil) and then two more clutches were collected.

Monomethyl mercury chloride was studied both by the oral and injected route. The smaller number of eggs in the experimental groups for this compound is due to marked inhibition of egglaying. The length and breadth of each egg was measured before the shell was ashed overnight at 1000°. Ashed weight was considered to be a more accurate assay of calcium content than thickness for a species laying small eggs. For the ring doves, no effect was observed. The kestrel's diet consisted of one day old dead chicks. The dead chicks were injected with dimethyl mercury dissolved in semane oil in the breast region immediately before being fed to the hawk. Amounts injected were calculated to give 10 ppm in the total diet. Control birds were fed chicks injected with semane oil only. The kestrels were on diet for about three months before egg-laying commenced. The thickness of the shells remained exactly constant at 0.72 mm and the Ratcliffe Index was 1.-0±0.03 for controls and 0.95±0.04 for those fed mercury. This change was not statistically significant at the 5 percent level.

239. Pearce, P.A. 1967.
SUMMARY STATEMENT ON THE EFFECTS ON BIRD POPULATIONS OF NOVATHION, SUMITHION AND SUMITHION-PHOSPHAMIDON MIXTURES, NEW BRUNSWICK - 1967.
Can. Wildl. Serv. Pestic. Sect. M.S. Rep. 7. 39 pp.

No abstract located.

240. Pearce, P.A., and S.M. Teeple. 1969.
EFFECTS OF FOREST SPRAYING OF SUMITHION ON BIRDS AND AMPHIBIANS IN NEW BRUNSWICK.
Can. Wildl. Serv. Pest. Sect. M.S. Rep. 19. 7 pp.

No abstract located.

241. Pearce, P.A., I.M. Price, and L.M. Reynolds. 1976.
MERCURY IN WATERFOWL FROM EASTERN CANADA.
J. Wildl. Manage. 40(4): 694 - 703.

Average wet-weight concentrations of total mercury were 0.15 and 0.31 ppm in breast muscle of 146 dabbling (*Anatinae*) and 61 diving ducks (*Aythyinae*) from 21 sites in eastern Canada sampled prior to the 1970 hunting season and during the 1971 season. Concentrations exceeded 0.5 ppm in only a few samples, mostly taken near known industrial sources of mercury contamination. In 129 pooled samples of muscle from the wings of 1,480 ducks harvested in 13 regions during the 1970 season, mercury concentration averaged 0.13 ppm in both dabblers and divers. A highly significant relationship between mercury levels in wing muscle and those in breast muscle was found in black ducks (*Anas rubripes*) and lesser scaups (*Aythya affinis*). Ducks collected in 1971 and 1972 from the Wabigoon-English River watershed in northwestern Ontario were very highly contaminated, extreme concentrations of 9.43, 9.10 and 14.7 ppm being noted in the breast muscle of the mallard (*Anas platyrhynchos*), blue-winged teal (A. *discors*), and the common goldeneye (*Bucephala clangula*), respectively. There was a suggestion that ducks collected within 80 km of the industrial source of mercury at Dryden had higher residues than those collected farther downstream. Wabigoon-English River waterfowl mercury levels declined as the hunting season progressed, possibly due to the influx of uncontaminated ducks from the west and north.

242. Pearson, J.E., K. Tinsley, and T. Hernandez. 1973.
DISTRIBUTION OF DIELDRIN IN THE TURTLE.
Bull. Environ. Contam. Toxicol. 10(6): 360 - 364.

Pilot studies using the turtle revealed its value in distribution studies and as a sentinel animal to detect compounds presenting a potential health menace. A number of turtles weighing 300 g to 1 kg were injected with 20 mg/kg of dieldrin in a 1:1 solution of diethyl ether and corn oil (50 mg/kg). The rate of absorption after injection was slow and unpredictable. Muscle tissue had a tendency to concentrate dieldrin early after injection. Next ot the fat, the liver had the greatest propensity to concentrate dieldrin.

243. Peterson, J.W. 1969.
THE EFFECTS OF SUMITHION ON BIRDS. 41 pp.

A co-operative study of the insecticide sumithion by USDA Forest Serv., USDI Bureau of Sport Fish. Wildl.; Marine State Forest Service. No abstract located.

244. Peterson, J.W. 1971.
THE EFFECTS OF ACCOTHION (FENITROTHION) ON BIRDS AND OTHER FAUNA., Pages 81 - 88 in Nash, R.W, J.W. Peterson, and J.F. Chansler, eds. ENVIRONMENTAL STUDIES OF ACCOTHION FOR SPRUCE BUDWORM CONTROL.
A co-operative study by the State of Maine, U.S. DEpt. Agric., and U.S. Dept. Interior.

Three techniques were employed to evaluate the impact of Accothion on birds: 1) Pre- and post-spray bird censuses, 2) Carcass searches and 3) Bird brain cholinesterase determinations. The significant bird or mammal kill occurred after two treatments of 2 oz/acre.

245. Peterson, S.R., and R.S. Ellarson. 1975.
TOTAL MERCURY RESIDUES IN LIVERS AND EGGS OF OLDSQUAWS.
J. Wildl. Manage. 40(4): 704 - 709.

Total mercury was determined in 99 oldsquaw (*Clangula hyemalis*) livers and 11 composite clutches collected on Lake Michigan and in northwest Hudson Bay. Residue levels were similar in different sex and age-classes collected during the same time period on Lake Michigan. Mercury levels were higher in oldsquaw collected in Hudson Bay than in those taken on Lake Michigan. Residues in the hen and clutch were positively correlated. Mercury in duckling livers was negatively correlated with the weight of the liver.

246. Philleo, W.W., and S.C. Fang. 1968.
EFFECT OF 2,4-D ON INCORPORATION OF 14C INTO URINARY METABOLITES FROM RATS RECEIVING 14C-LABELED ACETATE.
Agric. Food Chem. 16(2): 358 - 360.

The small amount of radioactivity recovered in the rat urine from oral-administered 14C-labeled acetate consisted of several different metabolites, one of which was identified as urea. The relative abundance of labeled metabolites was dependent upon the sex of the rat and 14C labeled acetate. A single dose of 2,4-D at 100 mg per rat, altered the pattern of radioactive metabolites found in the urine. In females, the effect of 2,4-D was greater on the metabolism of the methyl carbon than on the carboxyl carbon of acetate.

247. Pillmore, R.E. 1973.
TOXICITY OF PYRETHRUM TO FISH AND WILDLIFE. Pages 143-165 in E. John, ed.
PYRETHRUM: THE NATURAL INSECTICIDE.
Academic Press, New York.

Pyrethrum was aerially applied to a forest ecosystem at 0.1 and 0.2 lb/acre to evaluate the short- and long-term effects on non-target organisms. Sensitive insects were severely affected but fish were not. Birds suffered neither direct nor long-term effects attributable to pyrethrum. Residues of pyrethrins on tree foliage and in water were greatly reduced or not detectable at one to five days after treatment. Insecticidal dosages of pyrethrum appear to have a minimal direct impact on fish and wildlife and no long-term effects in the forest ecosystem.

248. Pimentel, D. 1971.
ECOLOGICAL EFFECTS OF PESTICIDES ON NON-TARGET SPECIES.
Office of Science and Technology. Wash. D.C. 220 pp.

A compilation of published data, mostly concerned with LD_{50} VALUES. It covers work done on plants, arthropodes, amphibians, fishes, birds, and mammals, with 258 chemicals (based on 730 references). The report is arranged very well and is an important piece of work. All the chemicals and references are listed according to the type of chemical (i.e. fungicide, insecticide, etc.)

249. Pimentel, D. 1972.
ECOLOGICAL IMPACT OF PESTICIDES.
Environ. Biol. 72(2): 1 - 27.

The ecological effects of pesticides (insecticides, herbicides, and fungicides) were analyzed and an assessment made of the extent of damage to the diverse processes of the environmental life system. Some pesticides reduced some species population numbers in certain regions, altered the natural habitat under some conditions, influenced the normal behaviour including learning in animals, stimualted or suppressed growth in animals and plants, increased or decreased the reproductive capacity of animals, altered the nutritional content of foods, increased the susceptibility of certain animals to disease, and were concentrated in certain animals to a level 100,000 times that in the environment. The available evidence suggests that certain current pesticide usage methods have caused measureable damage to some species of birds, fishes and beneficial insects. The full extent of damage is impossible to assess accurately because only a few (less than 1,000) species of the estimated total of 200,000 species of plants and animals in the USA have been studied. Although data on the detrimental effects of pesticides on the life system are spotty at best, there is sufficient evidence for concern about pesticide use. To avoid compounding the mistakes of the past, the investigator concluded that caution should be exercised in employing any pesticide with the following characteristics: pesticides which can be easily concentrated in living organisms; pesticides which can be passed from link to link in the food chain and stored in the life system, and pesticides which persist in the environment.

250. Poonawalla, N.H., and F. Korte. 1971.
METABOLISM ON TRANS-CHLORDANE-14C AND ISOLATION AND IDENTIFICATION OF ITS METABOLITES FROM THE URINE OF RABBITS.
J. Agric. Food Chem. 19(3): 467 - 470.

Every day male rabbits were fed 14.3 mg transchlordane- 14C for 10 weeks. Toward the end of the feeding period 70% of the daily administered amount was excreted in urine as metabolites. Within a total period of 12 weeks, 70% of the total administered amount was excreted. Only in subcutaneous fat were hydrophilic metabolites not present. It is shown that trans-chlordane has a high rate of metabolism and excretion in mammals. Its storage in fatty tissue is relatively very small. One of the metabolites of trans-chlordane was isolated in a crystalline form from the urine and analyzed. The two components of chlorohydrin of chlordene were separated, crystallized, and analyzed. The analyses of one of these two were the same as those of the isolated metabolite. The exact position of the hydroxyl group was also determined. Thus the structural formula of the isolated metabolite was ascertained and a formula of the other metabolites of trans-chlordane was proposed.

251. Porter, R.D., and S.N. Wiemeyer. 1969.
DIELDRIN AND DDT: EFFECTS ON SPARROWHAWK EGGSHELLS AND REPRODUCTION.
Science 165 (3889): 199 - 200.

Sparrowhawks were given a diet containing DDT and dieldrin. Major effects were increased egg disappearance (eating of eggs or newly hatched young by parent), increased egg destruction, and reduced eggshell thickness.

252. Prouty, R.M., J.E. Peterson, L.N. Locke, and B.M. Mulhern. 1975.
DDD POISONING IN A LOON AND THE IDENTIFICATION OF THE HYDROXYLATED FORM OF DDD.
Bull. Environ. Contam. Toxicol. 14(4): 385 - 388.

In December, 1973 a common loon (*Gavia immer*) was found in a soybean field in Madison County, Mississippi. The bird was alive when found but was lying on its back and died shortly thereafter. Autopsy findings and results of chemical residue analysis are reported.

253. Remade, F. 1970.
BIRDS, PESTICIDES AND DEATH.
Sci. Progrès Découverte, Nov. 1970: 24 - 25.

An overview of some effects of commerical organo-fungicides and hydrocarbon pesticides on birds. Indirect effects (hormonal and life function upsets) are stressed as more important than direct mortalities. Implications to human health are discussed.

254. Ratcliffe, D.A. 1967.
DECREASE IN EGGSHELL WEIGHT IN CERTAIN BIRDS OF PREY.
Nature 215 (5097): 208 - 210.

The incidence of broken eggs in nests of peregrine falcon (*Falco peregrinus*) sparrowhawk (*Accipiter nisus*), and golden eagle (*Aquila chrysaetos*) in Britain has increased considerably since 1950. In 109 peregrine eyries examined in 1904-50, there were only three instances of egg breakage compared with 47 in 168 eyries examined in 1951-66. Two of 35 golden eagle eyries examined in 1936-50 contained broken eggs compared with 12 our of 48 examined in 1951-63. One breakage was found in 24 sparrowhawk nests in 1943-50, but eight in 27 nests in 1951-60. Peregrines have been witnessed eating their own eggs, and most recent egg breakages in all three species appeared to involve parental destruction.

Egghshell thickness, frequency of breakage, decrease in egg weight and exposure to persistent pesticides are correlated. A brief description of the physiology of pesticide induced changes in eggshell formation is presented.

255. Ratcliffe, D. A. 1970.
CHANGES ATTRIBUTABLE TO PESTICIDES IN EGG BREAKAGE FREQUENCY AND EGG SHELL THICKNESS IN SOME BRITISH BIRDS.
J. Appl. Ecol. 7(1): 67 - 107.

The paper correlates the data of increased usages of pesticides with the period of abnormally high egg shell breakage; concluding that pesticides are the cause of egg breakage. Organochlorines are the most frequently mentioned group of pesticides.

256. Reichel, W.L., L.N. Locke, and R.M. Prouty. 1974.
PEREGRINE FALCON SUSPECTED OF PESTICIDE POISONING.
Avian Dis. 18(3): 487 - 489.

An adult female peregrine falcon (*Falco pergrinus*) was found dead with a 5.4 ppm concentration of dieldrin (known to cause death) in the brain tissue. Enteritis was also discovered but the dieldrin poisoning was considered the proximate cause of death.

257. Reichel, W.L., E. Cromartie, T.G. Lamont, B.M. Mulhern, and R.M. Prouty. 1969.
PESTICIDE RESIDUES IN EAGLES.
Pestic Monit. J. 3(3): 142 - 144.

Bald (*Haliaeetus leucocephalus*) and golden (*Aquila chrysaetos*) eagles found sick or dead in 18 states and Canada during 1964-65 were analyzed for pesticide residues. Residues in bald eagles were considerably higher than in golden eagles. Residues of DDE, DDD, and dieldrin were detected in all samples of bald eagle carcasses; other compounds found less frequently were heptachlor epoxide, endrin, and DCBP, a metabolite of DDE. DDE was detected in all samples of golden eagle carcasses; DDD, DDT, dieldrin, and heptachlor epoxide were detected less frequently.

258. Reidinger, R. F. 1976.
ORGANOCHLORINE RESIDUES IN ADULTS OF SIX SOUTHWESTERN BAT SPECIES.
J. Wildl. Manage. 40(4): 677 - 680.

Fifty adult bats collected in Arizona and Sonora, Mexico, including long-nosed (*Leptonycteris sanborni*), leaf-nosed (*Macrotus waterhousii*), pallid (*Antrozous pallidus*), big brown (*Eptesicus fuscus*), western pipistrelle (*Pipistrellus hesperus*), and Mexican free-tailed bats (*Tadarida brasiliensis*), were analyzed for organochlorine residues. All contained DDE (range, 0.1 - 160 ppm; median, 4.3 ppm wet weight basis) and DDT (range, 0.1 - 500 ppm; median, 0.2 ppm). DDD was found in 38 bats, dieldrin in 16, o,p' - DDT (at 33 - 200 ppm) in three, toxaphene in three,aroclor 1254 in one, and aroclor 1260 in one. Bats with the highest residue levels were collected in or near human dwellings. The five herbivorous long-nosed bats average only 0.51 ppm DDT and metabolites, whereas the others, all insectivores, averaged 46 ppm.

259. Revzin, A.M. 1969.
SOME ACUTE AND CHRONIC EFFECTS OF ENDRIN ON THE BRAINS OF PIGEONS AND MONKEYS.
Pages 134 - 141 in J. W. Gillett, ed. THE BIOLOGICAL IMPACTS OF PESTICIDES IN THE ENVIRONMENT.
Symp. Proc. Oregon State Univ. Environ. Health Sci. Ser. 1. 210 pp.

Evidence is presented showing that pesticides can affect brain bioelectric phenomena at doses well below those causing seizures or other gross behavioral changes. Chronic administration of high levels of endrin induce seizures in squirrel monkeys. Some months after termination of endrin administration, the seizures recurred -- under stress conditions. It is suggested that this phenomenon may be due to a stress-induced release of endrin from body fat; thus some implications regarding human and wildlife populations may be drawn.

260. Richardson, A., MBaldwin, and J. Robinson. 1968.
IDENTIFICATION OF METABOLITES OF DIELDRIN (HEOD) IN THE FAECES AND URINE OF RATS.
J. Sci. Food Agric. 19: 524 - 529.

Two metabolites of HEOD have been isolated by chromatographic techniques, one from the faeces and one from the urine of rats fed for six months on a diet containing HEOD. The moledular formulae of the urinary and faecal metabolites are respectively, $C_{12}H_7O_2Cl_5$ and $C_{12}H_8O_2Cl_6$. Structural formulae for the two compounds are suggested.

261. Risebrough, R.W., G.L. Florant, and D.D. Berger. 1970.
ORGANOCHLORINE POLLUTANTS IN PEREGRINES AND MERLINS MIGRATING THROUGH WISCONSIN.
Can. Field Nat. 84(3): 247 - 253.

Biopsy samples were taken from 10 peregrine falcons and seven merlins, and checked for chlorinated hydrocarbons. DDE is the topic of discussion throughout the paper but there is a mention of dieldrin, endrin and PCBs. Some conclusions drawn in the study were concentrations of DDE parallel PCB; PCBs are three times as abundant in the brown pelican as DDE.

262. Robel, R.J., C.D. Stalling, M.E. Westfahl, and A.M. Kadoum. 1972
EFFECTS OF INSECTICIDES ON POPULATIONS OF RODENTS IN KANSAS, 1965 - 1969.
Pestic. Monit. J. 6(2): 115 - 121.

The general objective of this study was to determine the effect of recommended applications of commonly used insecticides on population dynamics of unconfined rodents in two sites in Ellis County, Kansas. Six insecticides (diazinon, endrin, heptachlor, parathion, methyl parathion, and aldrin) were applied to one field, while a second field served as a control. Insecticide applications began in summer 1965 and continued through summer 1968. Live trapping of rodents was conducted on the treated field and the control field from 1965 through 1969. Specimens were collected each month for residue analysis. Only minor differences between experimental and control plots were found.

263. Robens, J. F. 1969.
TERATOLOGICAL STUDIES OF CARBARYL, DIAZINON, NOREA, DISULFIRAM, AND THIRAM IN SMALL LABORATORY ANIMALS.
Toxiocol. Appl. Pharmacol. 15(1): 152 - 163.

All the compounds, except for norea, have shown teratogenic effects in the chick embryo; noreo has not been tested.

264. Robinson, J., V.K.H. Brown, A. Richardson, and M. Roberts. 1967.
RESIDUES OF DIELDRIN (HEOD) IN THE TISSUES OF EXPERIMENTALLY POISONED BIRDS *(COTURNIX COTURNIX JAPONICA, COLUMBA LIVIA)*.
Life Sci. 6(11, pt. 1): 1207 - 1220.

The concentration of HEOD (the major component of technical dieldrin) in the brains and livers of Japanese quail and pigeons that died after various treatments with HEOD have been determined. The concentration in the brain was independent of the treatment as regards dose, time to death, and loss of weight before death. The concentration in the liver was also independent of the dose and loss of weight before death, but there was a tendency for the concentration to increase as the time to death increased.

The mean (geometric) concentration of HEOD in the poisoned Japanese quail were: brains, 17.4 ppm, livers, 40.0 ppm; the corresponding means for the pigeons were: brains, 20.0 ppm, livers, 45.6 ppm.

265. Rowe, F.P., F.J. Smith, and T. Swinney. 1974
FIELD TRIALS OF CALCIFEROL COMBINED WITH WARFARIN AGAINST WILD HOUSE MICE (*MUS MUSCULUS*).
J. Hygiene 73 (3): 353 - 360.

This paper deals with a study in Great Britain to control rodents. The study concluded that calciferol at 0.1% plus warfarin at 0.025% is an effective combination against house mice, especially when used with whole canary seed.

266. Rowe, F.P., T. Swinney, and A. Bradfield. 1975.
FIELD TRIALS OF THE RODENTICIDE GOPHACIDE AGAINST WILD HOUSE MICE (*MUS MUSCULUS*).
J. Hyg. 74(1): 109 - 114.

The acute rodenticide gophacide was tested against urban infestation of the house mouse (*Mus musculus L.*) and treatment success was assessed from the results of census baitings conducted before and after each treatment. Seven of eight populations of mice living in premises where alternative food supplies were limited were successfully controlled when medium oatmeal bait containing gophacide at 0.1% was laid directly for four days. In further treatments against mice inhabiting more complex environments and having greater access to other food, the performance of gophacide at 0.1% and at 0.25% in a wholemeal flour/pinhead oatmeal/corn oil bait was compared with that of zinc phosphide at 3.0% in the same bait-base. The poison treatments were conducted for one or four days and always after three days prebaiting. Treatment success varied considerably irrespective of the type of treatment or of the poison used. In general, however, gophacide proved to be as effective as zinc phosphide for the control of mice.

267. Rudd, R.L., and R.E. Genelly. 1956.
PESTICIDES: THEIR USE AND TOXICITY IN RELATION TO WILDLIFE
California Dept. Game and Fish. Game Bull. 7. 209 pp.

A basic book on pesticides and wildlife. It is easy to read and understand. Most of the studies referred to in the book are studies done with DDT or its derivatives. Contains 1,031 references.

268. Rushmore, F.M. 1971.
EFFECTS OF ACCOTHION (FENITROTHION) ON BIRDS. (INTENSIVE STUDIES ON SAPSUCKERS)
Pages 88 - 100 in Nash, R.W., J.W. Peterson, and J.F. Chansler, eds. ENVIRONMENTAL STUDIES OF ACCOTHION FOR SPRUCE BUDWORM CONTROL. A co-operative study by the State of Maine, U.S. Dept. Agric. and U.S. Dept. Interior.

No evidence suggested that any of 74 sapsuckers observed were killed or seriously harmed by two applications of accothion. The techniques used for monitoring accomplished the objectives, and sapsuckers were a reliable indicator species. There is a substantial basis for future technique refinements. One man can accomplish all phases of the current techniques except one: he needs another person to help with the nest block preparation and the banding.

Hummingbirds may also have potential for monitoring. If so, sapsuckers and hummingbirds could be found and observed simultaneously.

269. Rutschke-Potsdam, E. 1972.
BIOCIDES AND BIRDS.
Falke 19(1): 6 - 15 [In German].

A thorough and systematic overview of the documented effects of pesticides (mainly insecticides) on birds, based on published material; no original research data presented.

270. Saha, J.G., and R.H. Burrage. 1976.
RESIDUES OF LINDANE AND ITS METABOLITES IN EGGS, CHICKS, AND BODY TISSUES OF HEN PHEASANTS AFTER INGESTION OF LINDANE - 14C VIA TREATED WHEAT SEED OR GELATIN CAPSULES.
Environ. Sci. Health B11 (1): 67 - 93.

A study was made of the contamination of pheasants, their eggs, and chicks with residues used as seed dressings for control of wireworms in cereal crops. One group of laying hen pheasants was fed 20 mg lindane-^{14}C in gelatin capsules while another was fed wheat seed treated with 100 ppm of lindane-^{14}C for 15 days. ^{14}C labeled residues in eggs increased sharply in the capsule treated group and reached an average maximum of about 19 ppm in 8 days. This level decreased to less than 0.5 ppm in about 50 days. Residues in hatched chicks were considerably lower than in the eggs. The highest concentrations of residues occurred in fatty tissues which decreased to nondetectable levels in 6 months time. Several chlorobenzene metabolites were identified in egg yolk and chick tissues. Chlorophenolic metabolites were indicated only in chicks.

271. Salvaterra, P., B. Lown, J. Morganti, and E. J. Massaro. 1973.
ALTERATIONS IN NEUROCHEMICAL AND BEHAVIOURAL PARAMETERS IN THE MOUSE INDUCED BY LOW DOSES OF METHYL MERCURY.
Acta Pharmacol. Toxicol. 33(3): 177 - 199.

No abstract located.

272. Sanders, H. O. 1970.
PESTICIDE TOXICITIES TO TADPOLES OF THE WESTERN CHORUS FROG (*PSEUDACRIS TRISERIATA*) AND FOWLER'S TOAD (*BUFO WOODHOUSEI FOWLER*).
Copeia. 1970: 246 - 251.

Static bioassays were conducted to determine the relative acute toxicities of 16 pesticides to week-old *Pseudacris triseriata* tadpoles and 18 pesticides to four and five-week-old *Bufo woodhousei fowleri* tadpoles. Toxic effects were measured by determination of the Median Tolerance Limit (TL_{50}) for 24, 48, 96 hours exposures, at 15.5°C. Endrin, an organochlorine insecticide, was the most toxic to *Pseudacris* tadpoles, and the second most toxic insecticide to *Bufo* tadpoles. Lindane was the least toxic insecticide to both species of tadpoles. Herbicides were generally less toxic than most insecticides. DDT was 2.2 times more toxic to four and five-week-old *Bufo* tadpoles after a 24 hour exposure, than to those from one to three weeks of age. An increased sensitivity to DDT was recorded for *Bufo* tadpoles from one through seven weeks of age.

273. Saxena, P., and C. Saxena. 1973.
EFFECT OF PYRETHRUM ON BODY AND ORGAN WEIGHTS, FOOD CONSUMPTION AND FACES PRODUCTION OF THE HOUSE SPARROW, *PASSER DOMESTICUS*.
Pyrethrum Post 12(3): 76.

The toxicity of pyrethrum to the common house sparrow, (*Passer domesticus* (L.), was investigated. Doses of 2, 3, and 4 mg/g of pyrethrum powder containing 1.3 percent pyrethrins (26, 39, and 52 mg pyrethrins/kg) were administered orally after mixing the required quantity of pyrethrum with bajra grains. Eight days of treatments were allowed. Eight days after the final treatment the birds were autopsied and organ weight recorded. Food consumption, faeces production, body weight and organ weight were lower in sparrows treated with pyrethrin powder (4 mg/g) than in controls. Greater flying tendency, hyperexcitability and loud chirping were also observed. No changes were noted among birds treated with 2 and 3 mg. It is suggested that pyrethrum, at the highest does, may have affected the hypothalamus.

274. Schafer, E. W., Jr., R. B. Brunton, N. R. Lockyer, and J. W. DeGrazio. 1973.
COMPARATIVE TOXICITY OF SEVENTEEN PESTICIDES TO THE QUELEA, HOUSE SPARROW AND RED-WINGED BLACKBIRD.

Toxicol. Appl. Pharmacol. 26: 154 - 157.

The acute po LD_{50} values of 17 commercial or experimental pesticides were determined for quelea (*Quelea quelea*), house sparrows (*Passer domesticus*), and red-winged blackbirds (*Agelaius phoeniceus*), and the acute dermal LD_{50} values for quelea and house sparrows. Close correlations suggested that po toxicity data for red-winged blackbirds and dermal toxicity data for house sparrows can be used as preliminary indicators of po and dermal toxicity to quelea, respectively.

275. Schneeweis, J. C., Y. A. Greichus, and R. L. Linder. 1974.
ORGANOCHLORINE PESTICIDE RESIDUE LEVELS IN NORTH AMERICAN TIMBER WOLVES - 1969-71.
Pestic. Monit. J. 8(2): 142 - 143.

Tongue and muscle tissue samples from 51 timber wolves captured in Minnesota and northwest Ontario in 1969 - 71 were analyzed. No determined residue levels exceeded the minimum analytical confidence limits established in a previous study by Greichus (1973). These limits are 0.01 ppm for lindane, heptachlor, heptachlor epoxide, aldrin dieldrin and DDE: 0.05 ppm for DDT and DDD; and 1.00 pp- for PCBs, endrin, and methoxychlor.

276. Schwartz, B. 1971.
PESTICIDES: MIST OF DEATH.
Age Books, Ecology series, West Haven, Connecticut. 61 pp.

No abstract located.

277. Schwartz, C. C., and J. G. Nagy. 1974.
PESTICIDE EFFECTS ON IN VITRO DRY MATTER DIGESTION IN DEER.
J. Wild. Manage. 38(3): 531 - 534.

Effects of six pesticides, bordeaux mixture, mema RM (methoxy ethyl mercury acetate), toxaphene, DDT, dieldrin and sevin upon digestion of an alfalfa hay substrate in vitro were examined. There was a significant decrease ($P < 0.05$) in digestion of dry matter by both penned and wild deer (*Odocoileus hemionus*) rumen bacteria at a pesticide concentration of 1000 ppm for all compounds except mean RM tested. with wild deer inoculum. Bordeaux mixture significantly decreased ($P < 0.05$) digestion of dry matter at 100 ppm. There was also a significant difference ($P < 0.05$) between digestion coefficients for control levels (no pesticide) of penned and wild deer.

278. Schwartz, C. C., J. G. Nagy, and C. L. Streeter. 1973.
PESTICIDE EFFECT ON RUMEN MICROBIAL ACTION.
J. Anim. Sci. 37(3): 821 - 826.

Results of this study indicate that bordeaux mixture, toxaphene, mema RM, DDT, EPN, zectran, dieldrin, parathion, mobam and aldrin significantly ($P < 0.05$) reduce in vitro dry matter and cell wall constituent digestion at pesticide concentrations of 1,000 ppm. No effect was noted with baygon, black-leaf 40, malathion and 2,4-D acid on either cell-wall constituent digestion or dry matter digestion in vitro. Sevin was inhibitory to cell-wall constituent digestion in vitro at 1,000 ppm but had no effect on in vitro dry matter digestion. There was no significant ($P < 0.5$) difference noted in in vitro digestion with a pesticide concentration less than 100 ppm. Since contaminated forage usually contains low residue concentrations it was concluded that pesticides would have a negligible effect on rumen microbial function. It is significant to note that levels required for inhibition were high with respect to levels encountered in the field. For most inhibitory compounds, to reach a concentration of 1,000 ppm in the rumen, the concentration of pesticide required would be so great that the amount would be well over the calculated LD_{50} for that compound.

Results also indicated that bordeaux mixture and 2,4-D acid fed to goats for 12 days at levels near 300 ppm had no effect on reducing cell-wall constituent or dry matter digestion. Differences in rumen pH between treatment and control groups were not detected.

279. Seindensticker, J. C., IV, and H. B. Reynolds, III. 1971.
THE NESTING, REPRODUCTIVE PERFORMANCE, AND CHLORINATED HYDROCARBON RESIDUES IN THE RED-TAILED HAWK AND GREAT HORNED OWL IN SOUTH-CENTREAL MONTANA.
Wilson Bull. 83(4): 408 - 418.

Nesting success for red-tailed hawks (*Buteo jamaicensis*) was 50 percent and for great horned owls (*Bubo virginianus*) it was 64 percent. All tissues and eggs contained relatively low levels of DDE, DDT, DDD, and dieldrin. Eggs contained PCBs. The great horned owl eggs did not have thin shells, but red-tailed hawk eggs had thin shells.

280. Shah, P. V., and R. E. Guthrie. 1973.
PENETRATION OF INSECTICIDES THROUGH ISOLATED SECTIONS OF THE MOUSE DIGESTIVE SYSTEM: EFFECTS OF AGE AND REGION OF INTESTINE.
Toxicol. Appl. Pharmacol. 25 (4): 621 - 624.

Penetration of dimethoate, DDT, dieldrin, malathion, and carbaryl was studies in a closed in vitro system. There were differences in penetration among insecticides with preparations from different sections of the digestive tract and among mice of differenct ages.

281. Shellenberger, T. E., B. J. Gough, and L. A. Escuriex. 1970.
COMPARATIVE TOXICTY OF ORGANOPHOSPHATE PESTICIDES IN WILDLIFE. PAGES 205 - 210 IN PESTICIDES SYMPOSIA. COLLECTION OF PAPERS PRESENTED AT INTER-AMERICAN CONFERENCE ON

TOXICOLOGY AND OCCUPATIONAL MEDICINE.
Halos Assoc. Inc., Miami, Florida.

No abstract located.

282. Sherman, H., and A. M. Kaplan. 1975.
TOXICITY STUDIES WITH 5-BROMO-3-SEC-BUTYL-6-METHYLURACIL
Toxicol. Appl. Pharmacol. 34(2): 189 - 196.

The herbicide bromacil exhibited a low order of acure toxicity as evaluated by oral, dermal and inhalation studies in mammals and by fish and wildlife studies. Bromacil fed to pregnant New Zealand white rabbits on days 8-16 of gestation at dietary levels of 0, 50 and 250 ppm was not teratogenic. In a three-generation six-litter reproduction study with rats, a dietary level of 250 ppm had no adverse effects upon reproduction and lactation performance; no pathologic changes were observed in weanling pups of the F_{3b} generation. Rats of both sexes were fed nutritionally complete diets containing 0, 50, 250 and 1250 ppm bromacil for two years. Except for a lower rate of weight gain, a slightly decreased food intake and a slightly lower foood efficiency among the female rats that received 1250 ppm bromacil, there was no nutritional, clinical, hematologic, urinary or biochemical evidence of toxicity, nor any envidence of carcinogenicity; there was, however, a suggestion of slight hyperplasia in the thyroids of animals given the highest dietary level. Beagle dogs of both sexes one-two years of age, fed nutritionally complete diets containing 0, 50. 250, and 1250 ppm bromacil for two years, showed no nutritional clinical, hematological, urinary, biochemical or pathologic evidence of toxicity.

283. Shilova, S. A., A. V. Denisova, G. A. Dmitriev, L. D. Voronova, and M. N. Bardier. 1971.
EFFECT OF SOME INSECTICIDES UPON THE COMMON MOLE.
Zool. Z. 50(6): 886 - 892. [In Russian, English Summary]

In the spruce forest region with an area of 50 ha (Perm' District) treated with 85 percent wettable sevin powder, the secondary harmful effect of the co-pound upon the common mole(*Talpa europea L.*) was studied. The concentration was 0.5 g/m^2. Moles were caught 10 days after each treatment and their viscera were analyzed. The chemical analysis of 185 biological samples (66 moles) showed the presence of sevin in 83.3 ± 4,5 percent. Its content was the highest in the genitalia; up to 20.0 mg/kg (12.5 on the average) in the uterus. The sharp decrease in numbers of moles immediately after treatments and the mass death of earthworms, principal food of moles, were noted. Data are given about sevin content in slugs, ants, ground beetles, and earth worms. It is suggested that the sharp decrease in numbers of moles is caused by both the death of single specimens and food deficiency.

284. Smith, F.A., R.P. Sharma, R.I. Lynn, and J.B. Low. 1974.
MERCURY AND SELECTED PESTICIDE LEVELS IN FISH AND WILDLIFE IN UTAH: II LEVELS OF MERCURY, DDT, DDE, DIELDRIN AND PCB IN CHUKARS, PHEASANTS AND WATERFOWL.
Bull. Environ. Contam. Toxicol. 12(2): 153 - 157.

Breast muscle tissues of chukars, pheasants, and waterfowl, as well as a limited number of adipose tissues from the body cavity of chukars and pheasants, were analyzed for Hg and pesticide levels. A Coleman Hg analyzer and the Street method for pesticide and PVC measurement were used. None of the chukar tissue, six percent of the pheasant tissue, and the waterfowl tissue contained Hg concentrations greater than the FDA 0.5 ppm limit. Only 2 percent of waterfowl contained dieldrin concentrations above the FDA 0.3 ppm tolerance level. None of the chukars or pheasants contained DDT + DDE above the 5.0 ppm FDA tolerance level. The majority of waterfowl tissue contained PCB levels higher than selected pesticide levels, with no definite relationship between Hg and pesticide levels or PCBs.

285. Smith, S.I., C.W. Weber, and B.L. Reid. 1970.
THE EFFECT OF INJECTION OF CHLORINATED HYDROCARBON PESTICIDES ON HATCHABILITY OF EGGS.
Toxicol. Appl. Pharmacol. 16(1): 179 - 185.

Dieldrin, aldrin, endrin, DDT, heptachlor, toxaphene, endosulfan, lindane, and strobane were injected via a corn oil carrier into fertile hen eggs as a test of their toxicity. Dieldrin (5 or 10 mg) injection into the albumin of fertile eggs prior to incubation caused decreases in hatchability of 30 and 45 percent respectively. In addition, chicks from the 10-mg treatment exhibited tremors and died within 24 hours, while the chicks given 5 mg all died within one week of hatching. Injection of 0.2 mg of endrin into fertile eggs after seven days of incubation decreased hatchability to 40 percent. Higher levels were very toxic and resulted in as low as 1.8 percent hatchability. Similarly, 3.0 mg of DDT per egg resulted in 10 percent hatchability. Lindane, at 2.0 mg and strobane at 6.0 mg/egg caused no decrease in hatchability. Aldrin, at 2.0 mg per egg and toxaphene and endosulfan, at 1.5 mg/egg resulted in no decrease in hatchability. The 1.5 mg injection of heptachlor resulted in 12 percent reduction in hatchability. All tested chicks appeared normal except those given dieldrin.

286. Stickel, L.F., and L.I. Rhodes. 1969.
THE THIN EGGSHELL PROBLEM. Pages 31 - 35 in J.W. Gillett (ed.) THE BIOLOGICAL IMPACT OF PESTICIDES IN THE ENVIRONMENT. Oregon State Univ. Corvallis.
A symposium.

A brief paper on eggshell thinning. DDT and its derivatives and dieldrin were mentioned throughout the paper. All works cited are lab experiments concerning coturnix quail, peregrine falcons and kestrels.

287. Stickel, W.H., L.F. Stickel, and J.W. Spann. 1969.
TISSUE RESIDUES OF DIELDRIN IN RELATION TO MORTALITY IN BIRDS AND MAMMALS. Pages 174 - 204 in M.W. Miller, and G.G. Berg, eds CHEMCIAL FALLOUT: CURRENT RESEARCH ON PERSISTENT PESTICIDES.
University of Rochester, N.Y.

An experiment was performed with *Coturnix* to learn what residue levels were indicative of death from dieldrin poisoning. Birds were fed diets containing 250, 50, 10 and 2 ppm dieldrin for periods up to 158 days. The dieldrin was 95 percent pure HEOD. When half a groups was dead, the other half was sacrificed for comparison of residues in dead and susvivors. Dosage levels controlled time to death, but did not control residue levels in the dead. Residues in liver and carcass proved to be misleading and complicated by changes in lipid content. Brain residues correlated well with death although residues in dead and survivors overlapped. Both residues of animals killed by dieldrin in the field and in other experiments are listed. Data agree in general for several species of birds and mammals. There is evidence, however, for species differences in average lethal brain residues. It is concluded that brain residues of 4 or 5 ppm (wet weight) or higher indicate that the animal was in the known danger zone and may have died from dieldrin. Brain residues averaged lower in wild than in experimental animals. Possible explanations include species differences, more stress and exertion in the wild, and over-representation in the field series of individuals that will die with low but lethal brain residues. The latter is supported by the fact that the first *Coturnix* to die in each sex and treatment group had the lowest brain residue of its group. Birds receiving 2 ppm dieldrin, and some receiving 10 ppm, were able to maintain low brain residues throughout the experiment. However, birds of the 10 ppm group could withstand little stress and mobilization of toxicant, for a few micrograms in the brain were lethal and bodies contained hundreds or thousands of micrograms.

288. Street, J.C., and S.E. Blau. 1972.
OXYCHLORDANE ACCUMULATION IN RAT ADIPOSE TISSUE ON FEEDING CHLORDANE ISOMERS OR TECHNICAL CHLORDANE.
J. Agric. Food Chem. 20(2): 395 - 397.

Oxychlordane storage in adipose tissue was studied in male and female rats fed pure cis- and/or trans-chlordane or technical chlordane at levels from 50 to 200 ppm for 15 days. Trans-chlordane resulted in greater oxychlordane storage than cis-chlordane in both sexes with lower accompanying parent isomer storage. Males fed either isomer stored less oxychlordane than females. Oxychlordane storage during simultaneous administration of both chlordane isomers, or of technical chlordane itself, showed additivity of oxychlordane formation with no interaction apparent. Results of incubating chlordane isomers with rat liver homogenates indicated that oxychlordane formation proceeds via a dehydrogenated intermediate, dichlorochlordene.

289. Strik, J.J.T.W.A. 1973.
TOXICITY OF HEXACHLOROBENZENE (HCB) AND HEXABROMOBIPHENYL (HBB).
Meded. Fac. Lanbouwwet. Rijksuniv. Gent 38(3): 709 - 716. [In English, English and Dutch Summaries.]

The acute toxicity of the polyhalogenated aromatic compounds (hexachlorobenzene, HCB: fungicide and hexabromobiphenyl, HBB; "flame-retardant") is very low. In contrast to the acute toxicity, the semichronic toxicity of HCB and HBB is much more. The effects of the polyhalogenated aromatic compounds are weight loss, tremor, liver injury and mortality. The most impressive response is porphyria. Studies using rat, rabbit, Japanese quail, chicken, kestrel, cormorant, blue heron, and humans were reviewed.

290. Stromberg, K.L. 1975.
SUB-LETHAL EFFECTS OF SEED TREATMENT PESTICIDES ON BREEDING HEN PHEASANTS.
Diss. Abstr. Int. B36(6): 2547 - 2548.

Three seed treatment pesticides, the fungicide captan and the insecticides dieldrin and diazinon, were tested for sublethal effects on laying female pheasants (*Phasianus colchicus*). Analysis of the reproductive status and crop contents of pheasants collected in the field showed that agricultural foods made up the largest portion of the diet of breeding birds. Residue analysis showed that 45 percent of the birds samples had consumed food contaminated with seed treatment pesticides. On the basis of laboratory and field results, it was concluded that the use as a seed treatment of diazinon alone or in combination with captan represents a potential hazard to the reproductive performance of pheasants. The degree of hazard depends on the availability and utilization of treated seed by pheasants. The amount of treated seed necessary to reach an effective dose rate was estimated to be six percent to 12 percent of the daily food intake of a breeding hen pheasant.

291. Su, M-Q, F.K. Kinoshito, J.P. Frawley, and K.P. duBois. 1971.
COMPARATIVE INHIBITION OF ALIESTERASES AND CHOLINESTERASE IN RATS FED EIGHTEEN ORGANOPHOSPHOROUS INSECTICIDES.
Toxicol. Appl. Pharmacol. 20(2): 241 - 249.

Eighteen organophosphorus insecticides were fed to 30-day old female rats for one week at various dietary levels. Measurements were made of the insecticides on aliesterases of serum and liver using diethylsuccinate and tributyrin as substrates. The cholinesterase activity of liver, serum, and brains of rats that received the same levels of the insecticide was also measured. In most cases, the dietary levels required to inhibit cholinesterase were considerably higher than the levels that inhibited aliesterases. When the aliesterase activity was depressed by feeding various levels of organophosphorus insecticides for one week, the amount of potentiation of the toxicity of malathion was closely related to the amount of inhibition of liver aliesterases regardless of which compound was fed.

292. Swanson, G.A., G.L. Krapu, and H.K. Nelson. 1972.
MERCURY LEVELS IN TISSUES OF DUCKS COLLECTED IN SOUTH-CENTRAL NORTH DAKOTA.
Proc. North Dakota Acad. Sci. 25: 84 - 93.

Neutron activation analysis was used to determine total mercury content in liver, kidney and breast muscle tissues of pintails (*Anas acuta*) that fed on uplands as well as in wetlands in south-central North Dakota, and shovelers (*Spatula clypeata*) that fed exclusively in wetlands. Tissues were obtained in 1969 and 1970 from adult birds during the spring and summer months and from juveniles collected during August of 1970 and others reared under penned conditions. A sample of food fed to the pen-reared birds was also examined for mercury.

Adult birds of both species contained individuals with concentrations of over 500 ppb mercury in their tissues. Individual adult pintails contained higher maximum levels of mercury in liver tissues than did shovelers: however, a greater percentage (83 percent) of adult shoveler liver tissues exceeded 500 ppb than did those of pintails (32 percent). Mercury levels in wild juveniles were lower than in adult birds but higher at the 0.05 probability level than in pen-reared birds of similar age. Levels in the liver and kidney tissues were of a similar magnitude, but breast muscle tissues were generally two to four times lower.

293. Swennen, C. 1972.
CHLORINATED HYDROCARBONS ATTACKED THE EIDER POPULATION IN THE NETHERLANDS.
T.N.O. - Nieuws, 27(10): 556 - 560.

After the early part of this century the eider duck regularly increased in number on the West Frisian Islands, but the 1960s saw a considerable reduction in the number of eider nests. The drop is attributed to the high mortality rate for adult female eiders in the breeding season. The excessive eider mortality, which in particular occurred in 1960 - 65, is correlated with the high amounts of chlorinated hydrocarbons telodrin and dieldrin drained into the North Sea via the Rhine River until 1965. After 1968 the eider population in the Netherlands slowly increased again.

294. Tejning, S. 1967.
MERCURY IN PHEASANTS (*PHASIANUS COLCHICUS L.*) DERIVING FROM SEED GRAIN DRESSING WITH METHYL AND ETHYL MERCURY COMPOUNDS.
Oikos 18: 334 - 344.

This investigation was intended to find out if the high mercury contents in Swedish seed-eating birds could be explained by the consumption of methyl and ethyl mercury-treated seed grain which had not been convered with earth during sowing.

Pheasants one through seven were shot in January, 1965, within an area which in March-April 1964 had to c. 40 percent and in September to c. 15 percent been sown with methyl mercury dicyandiamide-treated seed grain of cereals. The body weights mercury contents in musculature, liver, kidneys and plumage and mercury contents in claws are given.

Pheasants no. 11 - 18 were shot in the same area as pheasants one through seven in December, 1966. The seed grain had during this year been treated with mercury-free disinfectants. No mercury could be found in the organs, plumage or claws.

The total mercury consumption was calculated for pheasants one through seven to be 16.89; 8.49; 3.75; 2.63; 2.17; 0.51 and 0 mg, respectively, and for pheasants no. eight through ten 6.74; 2.02; and 0.18 mg, respectively.

295. Tejning, S. 1971.
BIOLOGICAL EFFECTS OF METHYL AND ETHYL MERCURY COMPOUNDS USED AS DININFECTANTS FOR SEED GRAIN ON DOMESTIC AND WILDLIFE.
Meded. Fac. Landbouwwet. Rijksuniv. Gent. 36(1): 50 - 57.

Seed dressing with organic mercury compounds to combat fungal disease dates back to 1915 and is still practiced mainly due to its effectivity and economic gain. A short survey of the harmful effects of methyl and ethyl mercury on wild and domestic life and on man since the introduction of these compounds in plant protection is given. The biological effects of methyl mercury in birds are illustrated by experiments in hens concerning its accumulation in their organs and plumage, its elimination in eggs and excrements and its influence on the health of the birds, their laying-habits and egg production including the occurrence of embryonic damages and the hatchability. Attention is drawn to the ability of methyl mercury to cause genetic disorders.

296. Thill, R.E., K.E. Severson, and Y.A. Greichus. 1972.
EFFECTS OF ALDRIN ON YOUNG PHEASANTS UNDER SEMI-NATURAL CONDITIONS.
Bull. Environ. Contam. Toxicol. 7(2-3): 188 - 192.

Young pheasants were raised in a habitat closely associated with insecticide treated fields. Effects of a recommended level of aldrin upon pheasant chicks were evaluated; and residue levels occurring in pheasant tissues under such conditions were determined. No conclusive results were found as birds died from factors other than toxosis. However, systematic aldrin levels were 5.4 times greater in the test birds than in control birds.

297. Thomas, J.A., J.W. Lloyd, M.T. Smith, M.G. Mawhinney, and C.G. Smith. 1973.
EFFECT OF TRANSFORMATION OF RADIOACTIVE TESTOSTERONE BY THE MOUSE PROSTATE GLAND.
Toxicol. Appl. Pharmacol. 25(4): 523 - 531.

The oral administration of varying doses (2.5 or mg/kg/d x 10) of dieldrin led to significant reductions in the accumulation of radioactive androgen by the mouse prostate gland. This was reflected not only by a reduction in the total accumulation of tritiated steroid ([^{3}H]T) by the prostate gland, but also by a decrease in the concentration of dihydrotestosterone ([^{3}H]DHT). The ratio of [^{3}H]T to [^{3}H]DHT remains similar intreated and control groups. The doses of dieldrin used had little effect upon sex accessory organ weights or prostatic fructose concentration. Dieldrin administration failed to alter gonadal weights. There was no change in the hepatic formation of radioactive. [1,2-^{3}H] testosterone in the dieldrin-treated animals, but dieldrin did produce increases in liver androgen hydroxylase activity. While the amounts of dieldrin used in these studies were quite high, this organochloride could, nevertheless, represent a potential deleterious chemical from the standpoint of the male reproductive system.

298. Thomason, J.N. 1974.
ENVIRONMENTAL CONTAMINANTS INVENTORY STUDY NO. 1: STATISTICS ON THE USE OF PEST CONTROL PRODUCTS IN CANADA.
Environment Canada, Lands Directorate. Rep. 35 54 pp.

This study reviews public sources of data pertaining to the use and sales of pest control in Canada. The various types of data are described and critically evaluated in terms of their potential usefulness to researchers involved in the study of pest control product use in both an environmental context, and in relation to agricultural management.

The national framework of statistics is examined in detail in the following chapter, Review of National Statistics. Provincial sources of data are appraised in the subsequent chapter, Survey of Provincial Data. An overview of the market for pest control products, and its changes over the past 25 years, is the major emphasis of the concluding summary chapter. Appendices, consisting of tables of some of the more significant data sources, conclude the study. Appendix 1 provides detailed tables of 25 years of National Sales Figures, and Appendix II offers some of the more useful provincial data.

299. Thompson, D.J., J.L. Emerson, R.J. Strenring, C.G. Gerbig, and V.B. Robinson. 1972.
TERATOLOGY AND POSTNATAL STUDIES ON 4-AMINO - 3,5,6, - TRICHLOROPIEOLINIC ACID (PICLORAM) IN THE RAT.
Food Cosmet. Toxicol. 10: 797 - 803.

Four groups of 35 Sprague-Dawley-derived rats were given daily oral doses of 0, 500, 750 or 1000 mg picloram/kg/day on days six through fifteen of gestation. Twenty-five dams from each group were killed on day 20 and the foetuses were examined for untoward effects; the remaining ten dams in each group were used in a postnatal study and were allowed to deliver and wean their litters. Dosage at 500 mg/kg/day produced no overt signs of toxicity, while rats given 750 or 1000 mg/kg/day developed hyperaesthesia and mild diarrhea after one through four days of treatment, and 14 maternal deaths occurred between days 8 and 17 of gestation in these dosage groups. In surviving dams, doses up to and including 1000 mg/kg/day affected neither maternal weights gains, litter size and resorption rate nor other reproductive parameters examined. Evidence of retarded foetal growth, as reflected by an increase in unossified fifth sternebrae, was observed in the treated groups. In the postnatal study, survival and development of pups was unaffected by treatment of the dams with picloram. It was concluded that oral administration of sub-toxic and even of maternally toxic doses of picloram during organogenesis produces neither teratogenesis not adverse effects on neonetal development in the Sprague-Dawley rat.

300. Tietjen, H.P., C.H. Halvorson, P.L. Hegdal, and A. M. Johnson. 1967.
2,4-D HERBICIDE, VEGETATION, AND POCKET GOPHER RELATIONSHIPS. BLACK MESA, COLORADO. USA.
Ecology 48(4): 634 - 643.

In a seven-year study on Black Mesa, Colorado, elevation 10,000 ft, 2,4-D herbicide treatment initially reduced forb abundance and northern pocket gopher

(*Thomomys talpoides*) population 80 to 90 percent. Both forbs and pocket gophers remained at low levels on one area but returned to pretreatment levels on the other area. The decline in pocket gopher numbers was caused by an inability to survive where their preferred food (forbs) was eliminated by herbicide treatment. The decline was not caused by movements of the animals from sprayed areas, or by direct or indirect toxicity of 2,4-D. The common grasses offer, at best, only a marginal diet for northern pocket gophers; only succulent grasses or those bearing corns or rhizomes yield a subsistence diet. Limited sampling did not indicate that the spray treatment affected the numbers of other small mammals.

301. Tinker, J. 1971
UNHEALTHY HERBICIDES.
New Scientist and Sci. J. 49(743): 593.

This paper reports on the Swedish Poisons and Pesticides Board's temporary one year ban on the use of the phenoxy herbicides, 2,-D, 2,4, 5-T and their relatives in places to which the public has access. This restriction applied to forests, parks, and roadside verges, which represent the main uses of these compounds in Sweden.

It also reviews a paper by Yvonne Lutz - Ostertag and Hubert Lutz, [1970, see No. 193 this bibliography] and expresses concern about mutagenic effects of herbicides.

302. Tucker, R.K., and D.G. Crabtree. 1970.
HANDBOOK OF TOXICITY OF PESTICIDES TO WILDLIFE.
U.S. Dept. Interior, Fish, Wildl, Serv. Res. Publ. 84. 130 pp.

This is a report on the testing of 108 pesticides used in thousands of formulations. For many of the newer compounds, these are the first tests on wildlife species. Acute toxicity data and a list of the common symptoms observed are presented for each pesticide. For some pesticides, the results of 30 day repeated oral toxicity or feeding tests are also included.

303. Tucker, R.K., and M.A. Haegele. 1971.
COMPARATIVE ACUTE ORAL TOXICITY OF PESTICIDES TO SIX SPECIES OF BIRDS.
Toxicol. Appl. Pharmacol. 20: 57 - 65.

Acute oral LD50 values were determined for 16 common pesticides on mallard ducks (*Anas platyrhynchos*), ring-necked pheasants (*Phasianus colchicus*), chukar partridges (*Alectoris graeca*), coturnix quail (*Coturnix coturnix japonica*), common pigeons (*Columba livia*), and house sparrows (*Passer domesticus*). Analyses of the data revealed that (1) the average sensitivity of any one species to the 16 pesticides did not differ statistically from that of any other species, and (2) at the same time, the species varied widely in their sensitivity to any given compound. The average range of the LD50 values for single chemicals in the six species was nearly 10-fold. With differences of this magnitude, it is recommended that extrapolation of toxicity data from one species to another be avoided.

304. Vermeer, K. 1971.
A SURVEY OF MERCURY RESIDUES IN AQUATIC BIRDS EGGS IN THE CANADIAN PRAIRIE PROVINCES.
Trans. N. Am. Wildl. Nat. Resour. Conf. 36: 138 - 152.

A survey was conducted of mercury residues in 22 aquatic bird species at 33 locations in Alberta, Saskatchewan, and Manitoba. Mercury levels in eggs of larids and fish-eating birds were generally higher than those in geese and ducks, presumably reflecting differences in feeding habits and biological magnification. Interspecific differences of mercury residues observed in aquatic bird eggs at the same breeding localities may reflect interspecific differences in diet as well as time and length of exposure to mercury. The highest mercury levels between 0.5 and 2.0 ppm, hatched successfully. Mercury residues in livers of California gull females averaged 5.5 times higher than in their eggs.

305. Vermeer, K., and F.A.J. Armstrong. 1972.
MERCURY IN CANADIAN PRAIRIE DUCKS.
J. Wildl. Manage. 36(1): 79 - 182.

Tissues of 190 ducks, shot on the Canadian prairie during the hunting seasons of 1969 and 1970, were analyzed for mercury residues. Residue levels of over 0.5 ppm were found only in breast muscle of common mergansers (*Mergus merganser*). Livers contained, on the average, 2.9 times as much mercury as breast muscles. Primary feathers contained, on the average, 12 times as much mercury as breast muscles of adult pintails (*Anas acuta*) and 22 times as much mercury as those of immature pintails. Mercury levels in primaries correlated with those in muscles for adults but not with those of immature ducks.

306. Vermeer, K., F.A.J. Armstrong, and D.R.M. Hatch. 1973.
MERCURY IN AQUATIC BIRDS AT CLAY LAKE, WESTERN ONTARIO.
J. Wildl. Manage. 37(1): 58 - 61.

Total mercury levels ranging from 2 to 16 ppm in eggs did not appear to affect the hatching and fledging of herring gulls (*Larus argentatus*). Mercury levels in breast muscles of five American widpeons (*Mareca americana*), 16 mallards (*Anas platyrhynchos*), 17 blue-winged teals (*Anas discors*), 21 common goldeneyes (*Bucephala clangula*), 17 common mergansers (*Mergus merganser*), and seven hooded mergansers (*Lophodytes cucullatus*) average 0.5, 6.1, 6.5, 7.8, 6.8, and 12.3 ppm, respectively at Clay Lake four - six weeks prior to the hunting season in 1971. Methyl mercury in five ducks ranged from 69 to 99 percent of total mercury. Crayfish (*Oronectes virilis*) muscle contained the highest mercury levels of food items found in esophagi and stomachs of ducks; the high values in breast muscles of hooded mergansers are likely related to their feeding on crayfish.

307. Villeneuve, D.C., D.L. Grant, and W.E.J. Phillips. 1972.
MODIFICATION OF PENTOBARBITAL SLEEPING TIMES IN RATS FOLLOWING CHRONIC PCB INGESTION.
Bull. Environ. Contam. Toxicol. 7(5): 264 - 169.

The age of the male rats did not influence the degree of enzyme induction by a particular compound. With female rats, chlordane had the same quantitative effect on sleeping times at 30 and 350 days. This type of sleeping time adaption had been observed in quail fed a dietary regime of p.p' - DDT and other DDT metabolites.

The most likely explanation for the modified sleeping times observed in this study is enzyme induction. However, one must also be aware that these compounds could elicit changes in central nervous system activity or in the pharmacokinetic parameters in the central nervous system.

308. Vos, J.G., H.L. van der Mass, A. Musch, and E. Ram. 1971.
TOXICITY OF HEXACHLOROBENZENE IN JAPANESE QUAIL WITH SPECIAL REFERENCE TO PORPHYRIA, LIVER DAMAGE, REPRODUCTION, AND TISSUE RESIDUES.
Toxicol. Appl. Pharmacol. 18(4): 944 - 957.

The fungicide hexachlorobenzene (HCB), was given for 90 days to Japanese quail at dietary concentrations of 0, 1, 5, 20, and 80 ppm. Tremora and mortality occurred in birds fed 80 ppm. Red fluorescence of tissues, liver damage (enlargement of nuclei and nucleoli, proliferation of bile ductules, necrosis of hepatocytes), erythrophagocytosis in the spleen, ceroid granules in the tubules of the kidney, reduced reproduction and reduce volume of eggs were found in birds from the 80 ppm group. Shell thickness index was unaltered. Increased liver weight, slight liver damage and enlarged fecal excretion of coproporphyrin occurred in the 5 ppm group; the no-effect level was established at 1 ppm. Significantly higher brain residues were found in male compared to female birds. HCB residues in birds of prey found in a certain area are higher than residues found in Japanese quail fed 1 ppm HCB.

309. Wadsworth, C.E. 1971.
THE EFFECTS OF HERBICIDE APPLICATION ON THE ANIMAL POPULATIONS OF ASPEN COMMUNITIES.
Ph. D. Thesis. Brigham Young Univ. 109 pp.

Approximately 475 acres of aspen, oak brush, and grass-forb-shrub- communities were treated with herbicides. [Herbicide used was not specified in abstract]. Bird populations were lower in the treated area during the nesting season (June), higher in the treated area during July and August and nearly the same in each area during September. Small mammal populations decreased significantly on the treated meadow plots. *Microtus* populations increased while all other small mammals decreased in numbers on treated aspen plots. Use of the treated areas by mule deer was significantly reduced, while use of the same areas by elk was slightly increased.

310. Walker, C.H., G.A. Hamilton, and R.B. Harrison. 1967.
ORGANOCHLORINE INSECTICIDE RESIDUES IN WILD BIRDS IN BRITAIN.
J. Sci. Food Agr. 18(3): 123 - 129.

Organochlorine insecticide residues in a wide range of wild birds and their eggs from all over Britain have been determined by gas-liquid chromatography and paper chromatography. Higher residues were found in predatory species than in omnivorous or herbivorous species. To illustrate the residue pattern in predatory species analytical data for specimens of the heron, kestrel, and sparrow-hawk have been summarized. The source of the residues and their possible effects upon birds are discussed.

311. Ward, A.L. 1973.
SAGEBRUSH CONTROL WITH HERBICIDES HAS LITTLE EFFECT ON ELK CALVING BEHAVIOR.
Rocky Mt. For. Rang. Exp. Sta. U.S.D.A. For. Serv. Res. Note EM-240, 4 pp.

No abstract located.

312. Ware, G.W., and E.E. Good. 1967.
EFFECT OF INSECTICIDES ON REPRODUCTION IN THE LABORATORY MOUSE. III TRANID AND G.C. - 9160. J. Econ. Entomol. 50: 530 - 532.

No abstract located.

313. Wasserman, M., D. Wasserman, E. Kedar. M. Djavaherian, S. Cucos, and S. Ventura. 1973.
EFFECT OR ORGANOCHLORINE COMPOUNDS ON SERUM PROTEINS.
Bull. Environ. Contam. Toxicol. 10(1): 42 - 50.

The inter-relationship between organochlorine compounds (OCCs) and the serum level of protein fractions in rabbits receiving the compounds was examined. Sixty rabbits were divided into six groups, one group was given no OCCs, and the other five were given various amounts of DDT, dieldrin, and arochlor 1221. After p,p'-DDT administration, the increased plasma levels of DDT were accompanied by increased levels of dieldrin and PCBs, although the animals did not receive a dosage of those OCCs except what was already present in the food and water. Dieldrin administration led to a concomitant increase in total DDT plasma level. Variations in plasma levels of different OCCs as a result of feeding a given compound may explain the differences in the degree of toxicity based on the resultant of metabolic inter-relationships of OCCs in the animal body.

314. Webb, R.E., R.W. Hartgrove, W.C. Randolf, V.J. Petrella, and F. Horsfall, Jr. 1973.
TOXICOLOGY STUDIES IN ENDRIN-SUSCEPTIBLE STRAINS OF PINE MICE.
Toxicol. Appl. Pharmacol. 25(1): 42 - 47.

Oral LD_{50} studies were conducted in strains of endrin susceptible and resistant pine mice. The degree of resistance to endrin decreased in the orchard (where they were trapped) when endrin application as a control measure was terminated. Endrin resistant mice showed a two fold degree of cross resistance to dieldrin and an absence of cross-resistance to the organophosphate gophacide and to the indirect anticoagulant chlorophacinone. Both gophacide and chlorophacinone were more lethal to the endrin-resistant mice. Endrin toxicity studies in offspring indicated the resistance is heritable in first generation progeny.

315. Weil, C.S., M.D. Woodside, C.P. Carpenter, and H.F. Smyth, Jr. 1972.
CURRENT STATUS OF TESTS OF CARBARYL FOR REPRODUCTIVE AND TERATOGENIC EFFECT.
Toxicol. Appl. Pharmacol. 21(3): 390 - 404.

A three-generation rat reproduction study with technical carbaryl (1 naphthyl methylcarbamate) added to the diet to provide daily doses up to 10 mg/kg and up to 500 mg/kg resulted in no statistically significant dose related effect upon fertility, gestation, viability of pups or lactation. Guidelines for an acceptable experimental design of studies to evaluate human risks are discussed in relation to published articles and unpublished reports on the effect of carbaryl on animal reproduction or teratology.

316. Westermark, T. 1967 or 1973.
MERCURY CONTENT IN HUNGARIAN PARTRIDGE AND IN THEIR NORTH-CENTRAL MONTANA ENVIRONMENT, in Buhler, E.D., ed. MERCURY IN THE WESTERN ENVIRONMENT. Oregon State Univ. Press, Cornwallis. 360 pp.

No abstract located.

317. Whitacre, D.M., and G.W. Ware. 1967.
RETENTION OF VAPORIZED LINDANE BY PLANTS AND ANIMALS.
J. Agric. Food Chem. 15(3): 492 - 496.

Chickens, rats, mice, frogs, fish and seven species of plants were exposed to vaporized lindane in a greenhouse cubicle for periods varying from seven to 46 days. Nearly all animal tissue or organs and plants showed significant storage of lindane, including egg yolks from test chickens. Tableware and other inert surfaces bore varying amounts of lindane. The only test animals wisibly affected by the vapor were the test fish, all of which died during the exposure.

318. White, D. H., and R. G. Heath. 1976.
NATIONWIDE RESIDUES OF ORGANOCHLORINES IN WINGS OF ADULT MALLARDS AND BLACK DUCKS, 1972 - 73.
Pestic. Monit. J. 9(4): 176 - 185.

Organochlorine residues in wings of adult mallards and black ducks were monitored during the 1972-73 hunting season. DDE, DDT, DDD, diedlrin, and polychlorinated biphenyls (PCBs) were present in all samples. Mallard wings from Alabama contained the highest levels of DDE, DDT, DDD, dieldrin and PCBs. Mallards and black ducks from the Atlantic Flyway and mallards from the Pacific Flyway contained significantly lower DDE residues than in 1969-70. Black ducks from the Atlantic Flyway contained significantly lower levels of PCBs. As in 1969-70, DDE residues were lowest in the Central Flyway and highest in the Atlantic Flyway. The average PCB level remained unchanged in the Atlantic Flyway but was higher in the Mississippi Flyway than in 1969-70, probably because of the unusually high levels in Alabama samples. All organochlorine residues in black ducks from the Atlantic Flyway significantly correlated. DDE concentrations in mallards from the Atlantic Flyway significantly correlated with those of DDT, DDD, and PCBs.

319. White, D. H., and T.E. Kaiser. 1976.
RESIDUES OF ORGANOCHLORINES AND HEAVY METALS IN RUDDY DUCKS FROM THE DELAWARE RIVER. 1973.
Pestic. Monit. J. 9(4): 155 - 156.

PCB, DDT, dieldrin and HCB were found in carcasses of eight ruddy ducks killed in an oil spill. All contained lead, cadmium, and mercury in their liver.

320. Wiemeyer, S.N., B.M. Mulhern, F.J. Ligas, R.J. Hensel, J.E. Mathisen, F.C. Robards, and S. Postupalsky. 1972.
RESIDUES OF ORGANOCHLORINE PESTICIDES, POLYCHLORINATED BIPHENYLS, AND MERCURY IN BALD EAGLE EGGS AND CHANGES IN SHELL THICKNESS - 1969 and 1970.
Pestic. Monit. J. 6(1): 50.

Twenty-three bald eagle eggs collected in Alaska, Maine, Michigan, Minnesota, and Florida during 1969 and 1970 were analyzed for organochlorine pesticides, polychlorinated biphenyls, and mercury. All eggs contained residues of DDE, dieldrin, PCBs, and mercury. Average residue concentrations were lowest in eggs from Alaska. Significant eggshell thinning has occurred among eggs from most major areas sampled. Some eggs contained DDE residues of the same magnitude as those that produced shell thinning in experimental species. High dieldrin residues in some eggs could be having an adverse effect on reproductive success.

321. Wood, J.M. 1971.
ENVIRONMENTAL POLLUTION BY MERCURY. Pages 39 - 56 in Pitts, J.N., and R.L. Metcalf, eds. ADVANCES IN ENVIRONMENTAL SCIENCE AND TECHNOLOGY. Vol. 2. Wiley-Interscience. N.Y. 344 pp.

A general paper on mercury pollution and Minamata disease in Japan, Sweden and Canada.

322. Wurster, C.F. 1969.
CHLORINATED HYDROCARBON INSECTICIDES AND AVIAN REPRODUCTION: HOW ARE THEY RELATED? Pages 368 - 389 in Miller, M.W., and G.G. Berg, eds. CHEMICAL FALLOUT. CURRENT RESEARCH ON PERSISTENT PESTICIDES. Univ. Rochester, N.Y.

The stability, solubility characteristics, and broad toxicity of certain chlorinated hydrocarbon insecticides are responsible for worldwide contamination of food chains associated with a potential for biological effects on many kinds of organisms. The compounds increase in concentration with increasing trophic level, generally reaching highest concentrations in carnivores, including carnivorous birds. On at least two continents, a pattern of diminished reproductive success of carnivorous birds coincides with the presence of chlorinated hydrocarbon residues, particularly those of DDT.

Included are such birds as grebes, woodcock, various birds of prey, seabirds and possibly others that have not been studied, although exceptions to these correlations exist. Additional information comes from various laboratory experiments and field observations including feeding experiments, egg injections, bird behavior, chick mortality, eggshell weight measurements, and enzyme induction. The data suggest that these chemicals interfere with calcium metabolism and hormonal mechanisms. Two mechanisms involving calcium metabolism are proposed to explain these observations: (1) Acute toxicity involves direct attack on the nerve axon with associated axon decalcification and symptoms of calcium deficiency. This mechanism can kill adult birds or chicks shortly after hatching. (2) Chlorinated hydrocarbons cause induction of hepatic enzymes that metabolize steroid hormones; estrogen breakdown is especially important, since estrogen influences calcium metabolism in birds. This would explain the widespread occurrence of calcium-deficient eggshells among carnivorous birds since introduction of DDT in the late 1940s. Current knowledge indicates, despite several anomalies, that certain chlorinated hydrocarbon insecticides are a probable cause of the widespread diminished reproduction of carnivorous birds.

323. Zabic, M.E., and R. Schemnel. 1973.
DIELDRIN STORAGE OF OBESE, NORMAL, AND SEMI STARVED RATS.
Arch. Environ. Health 27(1): 25 - 30.

Dieldrin tissue levels in obese and normal weight adult male Osborne Mendel rats that were on weight maintenance or weight reduction diets were compared with levels immediately after dieldrin feeding. Normal weight animals exhibited higher tissue pesticide reductions while very little of the body burden of dieldrin was lost in obese rats. Neither group exhibited any elevation of dieldrin levels in the brain because of tissue mobilization.

INDEX OF COMMON AND SCIENTIFIC NAMES

OF ANIMALS

Numbers following the names refer to abstract numbers in the text, not to page numbers.

Species marked with an asterisk regularly occur in, have been exterminated from, or have been introduced into Manitoba.

*Acanthis flammea**, 162
*hornemanni**, 162
Accipiter cooperii *, 81, 236, 322
*gentilis**, 30, 31, 165
nisus, 31, 53, 99, 143, 150, 151, 165, 211, 228, 229, 232, 236, 248, 251, 253, 254, 310, 322
*striatus**, 81, 322
Acris creptans, 85
*Actitis macularia**, 66
*Aechmophorus occidentalis**, 53, 99, 211, 248, 304, 322
*Aegolius funereus**, 31, 150
*Agelaius phoeniceus**, 37, 43, 47, 81, 85, 88, 211, 247, 248, 274, 302
Aimophila cassinii, 204
Alauda arvensis, 232
Alca torda, 53, 99, 248, 310
*Alces alces**, 22, 248
Alectoris graeca, 191, 284, 301
rufa, 192, 248, 301
*Anas acuta**, 16, 46, 149, 171, 292, 302, 304, 305
*carolinensis**, 149, 247
*discors**, 46, 66, 85, 162, 241, 248, 304, 306
fulvigula, 16, 85
*platyrhynchos**, 16, 39, 53, 61, 66, 81, 84, 85, 88, 91, 99, 112, 113, 114, 118, 120, 122, 123, 124, 125, 126, 132, 141, 146, 148, 161, 185, 186, 195, 196, 205, 206, 227, 241, 247, 248, 249, 269, 286, 302, 303, 304, 306, 318
*rubripes**, 16, 120, 146, 148, 190, 206, 219, 241, 248, 318
*strepera**, 16, 46, 304
*Anser albifrons**, 85
*Antilocapra americana**, 104, 204, 212, 213, 248
Antrozous pallidus, 258
Apodemus flavicollis, 31
sylvaticus, 31, 146
*Aquila chrysaetos**, 7, 31, 81, 99, 148, 189, 236, 248, 251, 253, 254, 257, 302, 310, 322
pomarina, 269
Ardea cinerea, 31, 53, 99, 143, 310
*herodias**, 66, 75, 76, 248, 261, 289, 304
Arremonops conirostris, 162

- *Asio otus**, 31, 151, 248
- *Athene noctua*, 150, 162, 310
- Avocet, American*, 304
- *Aythya affinis**, 16, 46, 66, 99, 149, 241, 248, 304
  - *collaris**, 16, 248
  - *marila**, 16
  - *valisineria**, 16, 304

B

- Badger, American*, 204
  - European, 53
- Baldpate*, 46, 149, 304, 306
- *Bartramia longicauda*, 204
- Bat, Big Brown*, 258
  - Leaf-nosed, 258
  - Long-nosed, 258
  - Mexican Free-tailed, 258
  - Pallid, 258
- Bear, Black*, 23, 248
  - Polar*, 248, 249
- Beaver*, 248
- Bittern, American*, 66
- Blackbird, Brewers', 37, 81
  - European, 162
  - Red-winged*, See *Agelaius phoeniceus*
- *Blarina brevicauda**, 36, 98, 99
- Bluebird, Eastern*, 37, 322
  - Mountain*, 247
- Bobcat*, 85
- Bobolink*, 147
- Bobwhite, See *Colinus virginianus*
- *Bombycilla cedrorum**, 37, 87
- *Bonasa umbellus**, 87, 88, 98, 248
- *Botaurus lentiginosus*, 66
- *Branta canadensis**, 66, 85, 88, 137, 248, 302, 304, 310
- *Bubo bubo*, 31
  - *virginianus**, P1, 85, 88, 99, 279
- *Bucephala clangula**, 241, 306

*Bufo americanus**, 169
- *bufo*, 51, 223
- *cognatus*, 204
- *woodhousei*, 225, 248, 272

Bunting, Lark*, 204

Buteo buteo, 31, 53, 150, 151, 162, 165, 232, 248, 255, 269, 310
- *jamaicensis**, 80, 81, 88, 99, 279
- *lineatus*, 88
- *regalis*, 81
- *swainsoni**, 81

Buzzard, Common, See *Buteo buteo*
- Honey, 151

C

*Calamospiza melanocorys**, 204

*Calcarius ornatus**, 81, 204

Callorhinus ursinus, 4, 5, 248

*Canis latrans**, 204
- *lupus**, 275

Canvasback*, 16, 304

Capreolus capreolus, 31, 72, 248

Carduelis carduelis, 162

Caribou*, 248, 249

Carpodacus mexicanus, 248, 302
- *purpureus**, 37, 87, 244

Casmerodius alba, 66, 76

Cassidix mexicanus, 85

*Castor canadensis**, 248

Cat, Domestic*, 154,

Catbird*, 87, 88, 147

Cattle, Domestic*, 6, 9,

Centrocercus urophasianus, 45, 248

*Certhia familiaris**, 247

*Cervus elaphus**, 104, 206, 248

Chaffinch, 53, 162

*Charadrius semipalmatus**, 206
- *vociferus**, 66, 85, 204

*Chen caerulescens**, 32, 85, 206

Chickadee, Black-capped*, 37
Boreal*, 37, 87
Mountain, 247, 248
Chicken, Domestic*, 9, 60, 64, 95, 129, 130, 162, 163, 168, 192, 196, 202, 223, 285, 289, 317
Greater Prairie*, 205, 248, 302
Chipmunk, Eastern*, 36
Least*, 37
Chipmunks, general*, 98
_Chlidonias niger_*, 66, 88, 248
Chloris chloris, 31
Chlorura chlorura, 247
_Chondestes grammacus_*, 37, 204
_Chordeiles minor_*, 147, 204
Circus approximans, 210
_cyaneus_*, 7, 81, 99, 322
pygargus, 151
_Clangula hyemalis_*, 245, 248
Clethrionomys gapperi *, 36, 37, 248
glareolus, 146
Coccyzus americanus, 108, 147
_erythropthalmus_*, 37, 108
_Colaptes auratus_*, 37, 87, 244
cafer, 247
Coloeus monedula, 31
Colinus virginianus, 18, 102, 118, 121, 132, 143, 161, 162, 174, 205, 225, 231, 248, 302
_Columba livia_*, 40, 81, 99, 119, 143, 145, 235, 257, 264, 302, 303
palumbus, 31, 163, 310
_Contopus virens_*, 87, 98, 244
Coot*, 248
Cormorant, Double-crested*, See _Phalacrocorax auritus_
Great, 99, 134
_Corvus brachyrhynchos_*, 88
_corax_*, 206, 248, 255, 269
corone, 99, 248, 255, 269, 310
frugilegus, 248, 255, 269
Coturnix coturnix, 53, 62, 99, 109, 112, 136, 143, 173, 193, 194, 205, 223, 286
japonica, 12, 26, 44, 100, 102, 121, 130, 132, 161, 175, 177, 192, 264, 269, 287, 289, 302, 303, 308

Cowbird, Brown-headed*, See *Molothrus ater*

Coyote,* 204

Crane, Common, 31

  Sandhill*, 248, 302

  Whooping*, 182

Creeper, Brown*, 247

Crossbill, Red*, 37

  White-winged*, 37

Crotalus viridis, 204

Crow, Carrion, 248, 255, 269

  Common*, 88

Cuckoo, Black-billed*, 37, 108

  Yellow-billed, 108, 147

Curlew, Long-billed, 204

*Cyanocitta cristata**, 37, 87, 178

  stelleri, 247

Cygnus olor, 31

D

Deer, Mule*, See *Odocoileus hemionus*

  Roe, 31, 72, 248

  White-tailed*, 104, 206, 221, 248

*Delphinapterus leucas**, 248

Dendragapus obscurus, 248, 253

*Dendrocopos pubescens**, 98

  *villosus**, 37, 98, 247

Dendrocygna bicolor, 85, 205, 248, 302

Dendroica auduboni, 247

  caerulescens, 87, 147

  *castanea**, 87

  *coronata**, 37, 87, 98, 147, 244, 248

  *fusca**, 87

  *magnolia**, 87, 244

  *palmarum**, 147

  *pensylvanica**, 37

  *petechia**, 37

  *striata**, 147

  *tigrina**, 37, 87

  *virens**, 87

Dickcissel*, 85, 162
Dipodomys merriami, 55
  ordii, 204
Dog*, 176, 225, 282
*Dolichonyx oryzivorus**, 147
Domestic Ferret, 31, 302
Dove, Mourning*, See *Zenaidura macroura*
  Ring, 143, 238, 248
  Rock*, See *Columbia livia*
  White-winged, 248, 302
Dowitcher, Short-billed*, 85
*Dryocopus pileatus**, 37
Duck, Black*, See *Anas rubripes*
  Eider*, 248, 293
  Fulvous Tree, 85, 205, 248, 302
  Harlequin, 141
  Mottled, 16, 85
  Ring-necked*, 16, 248
  Ruddy*, 319
  Shell, 31
*Dumetella carolinensis**, 87, 88, 147
Dunlin*, 66, 162

E

Eagle, Bald*, See *Haliaeetus leucocephalus*
  Golden*, See *Aquila chrysaetos*
  Gray Sea, 248
  Lesser Spotted, 269
  White-tailed, 31, 53, 253, 269
Egret, Common, 66, 76
  Reddish, 85
Elk*, 104, 206, 248
Emberiza citrinella, 31
*Empidonax flaviventris**, 36
  *minimus**, 37, 87
  *trailii**, 87
  virescens, 98
  spp. 247
*Eptesicus fuscus**, 258

*Erignathus barbatus**, 90, 248
*Eremophila alpestris**, 81, 204
Ereunetes mauri, 85
Erithacus rubecula, 162, 249, 269
*Erolia alpina**, 66, 162
  *melanotos**, 85
*Euphagus cyanocephalus**, 37, 81
*Eutamias minimus**, 37

F

*Falco columbarius**, 53, 81, 93, 248, 261
  *mexicanus**, 7, 71, 81, 93, 94, 143, 248
  *peregrinus**, 7, 42, 53, 70, 83, 99, 143, 147, 206, 214, 232, 236, 248, 249, 253, 254, 256, 261, 269, 286, 310, 322
  *rusticolis**, 214
  *sparverius**, 7, 53, 87, 99, 143, 204, 238, 248, 249, 253, 286
  tinnunculus, 51, 53, 99, 150, 151, 162, 165, 232, 236, 248, 269, 289, 310, 322
Falcon, Peregrine, See *Falco peregrinus*
  Prairie, See *Falco mexicanus*
Ferret, Domestic, 31, 302
Finch, Green, 31
  House, 248, 302
  Purple*, 37, 87, 244
  Zebra, 162
Flicker, Red-shafted*, 247
  Yellow-shafted*, 37, 87, 244
Flycatcher, Acadian, 98
  Alder*, 87
  Crested, 178
  Great Crested*, 37
  Least*, 37, 87
  Olive-sided*, 37
  Yellow-bellied*, 36
Fox, Red*, 31, 72
Fratercula arctica, 53
Fringilla coelebs, 53, 162
Frog, Boreal Chorus*, 206, 248
  Bull, See *Rana catesbeiana*
  Common, 51, 92
  Green*, 98
  Leopard*, 66, 99, 156

Southern Cricket, 85
Western Chorus, 272
Wood*, 98
Frogs, general, 317
*Fulica americana**, 248
Fulmar, 53, 248
Fulmarus glacialis, 53, 248

G

Gadwall*, 16, 46, 304
Gallinula chloropus , 66, 85, 143, 248, 310
Gallinule, Common, See *Gallinula chloropus*
Gannet, 53, 248
Garrulus glandarius, 31
*Gavia immer**, 77, 252
*Geothlypis trichas**, 87, 147
Glaucidium gnoma, 31
*Glaucomys sabrinus**, 98
Goat*, 99, 248, 302
Goldeneye, Common*, 241, 306
Goldfinch, American*, 37
European, 162
Goose, Blue*, 32, 85
Canada*, See *Branta canadensis*
Snow*, 85, 206
White-fronted*, 85
Goshawk*, 31, 30, 163
Grackle, Boat-tailed, 85
Common*, 37, 85, 87, 88, 211
Grassquit, Blue-black, 162
Grebe, Great Crested, 53, 248, 310
Pied-billed*, 66, 85
Red-necked*, 82, 304
Western*, See *Aechmophorus occidentalis*
Grebes, general*, 77
Grosbeak, Evening*, 87, 244
Rose-breasted*, 37, 244
Grouse, Blue, 248, 253
Ruffed*, 87, 88, 98, 248
Sage, 45, 248

Sharp-tailed*, See *Pedioecetes phasianellus*

*Grus americana**, 182
*canadensis**, 248, 302
grus, 31

Guillemots, general 53, 248, 255, 310

Gull, Black-backed, 210
Black-headed, 31, 255
California, 304
Franklin's*, 204, 304
Herring*, See *Larus argentatus*
Laughing, 85
Mew, 31
Ring-billed*, 66, 77, 248, 304

Gymnorhina tibicen, 210

Gyrfalcon*, 214

H

Haliaeetus albicilla, 31, 53, 248, 253, 269
*leucocephalus**, 7, 20, 53, 54, 99, 107, 148, 170, 206, 218, 236, 248, 251, 253, 257, 302, 322

Halichoerus grypus, 90, 135, 248

Hare, Field, 31, 72, 74, 99, 128, 136, 157, 203
Mountain, 31

Harrier, Montagu's, 151

Hawk, Copper's*, 81, 236, 304
Ferruginous, 81
Harrier, 210
Marsh*, 81, 99, 322
Red-shouldered, 88
Red-tailed*, See *Buteo jamaicensis*
Sharp-shinned*, 81, 322
Sparrow, See *Accipiter nisus*
Swainson's*, 81

Heron, Black-crowned Night*, 7, 66, 75, 88
Great Blue*, See *Ardea herodias*
Grey, 53, 99, 143, 310

*Hesperiphona vespertina**, 87, 244

Himantopus mexicanus, 85

*Hirundo rustica**, 37, 206

Histrionicus histrionicus, 141
Horse*, 302
Hummingbird, Broad-tailed, 247
*Hylocichla fuscescens**, 37, 87, 147
    *guttata**, 87
    *ustulata**, 87, 147, 244

I

Ibis, White-faced, 85
*Icterus galbula**, 99, 178
*Iridoprocne bicolor**, 248

J

Jackdaw, 31
Jackrabbit*, 204, 248
Jay, Blue*, 37, 87, 178
    European, 31
    Gray*, 37, 247
    Steller's, 247
Junco caniceps, 247
    *hyemalis**, 37, 87, 244, 248, 302
Junco, Dark-eyed*, See *Junco hyemalis*
    Gray-headed, 247

K

Kestrel, American*, See *Falco sparverius*
    European, See *Falco tinnunculus*
Killdeer*, 66, 85, 204
Kingbird, Eastern*, 37
    Western*, 204
Kingfisher, Belted*, 322
Kinglet, Golden-crowned*, 36, 37, 247
    Ruby-crowned*, 36, 37, 87, 247
Kinglets, general*, 224
Kinosternon flavescens, 85
Kite, Everglade, 182
Kites, general, 232

Kittiwake, 99, 248, 255, 310

L

*Lagopus lagopus**, 206
Lagurus curtatus, 204
Lapwing, 31, 162
Lark, Horned*, 81, 204
*Larus argentatus**, 7, 53, 88, 99, 116, 206, 248, 269, 304, 306, 310, 322
    atricilla, 85
    californicus, 304
    canus, 31
    *delawarensis**, 66, 77, 248, 304
    dominicanus, 210
    *pipixcan**, 204, 304
    ridibundus, 31, 255
Leptonycteris sanborni, 258
*Lepus americanus**, 99, 248
    europaeus, 31, 72, 74, 128, 136, 157
    timidus, 31
    *townsendi**, 204, 248
*Limnodromus griseus**, 85
Longspur, chestnut-collared*, 81, 204
Loon, Common*, 77, 252
*Lophodytes cucullatus**, 306
*Loxia curvirostra**, 37
    *leucoptera**, 37
*Lynx rufus** 85

M

Macrotus waterhousei, 258
Magpie, Black-billed*, 31, 37, 248, 269
Mallard*, See *Anas platyrhynchos*
*Mareca americana**, 46, 149, 306
Marten, European Pine, 31, 72
*Martes martes**, 31, 72
Meadowlark, Eastern, 85
    Western*, 81, 204

- _Megaceryle alcyon_*, 322
- _Melanitta deglandi_*, 16
  - _perspicillata_*, 16
- _Meleagris gallopavo_*, 118, 196, 248, 302
- _Meles meles_, 53, 174
- _Melospiza lincolnii_*, 247
  - _melodia_*, 37, 87, 247
- _Mephitis mephitis_*, 204
- Merganser, Common*, 81, 305, 306
  - Hooded*, 306
  - Red-breasted*, 75, 82
- _Mergus merganser_*, 75, 305, 306
  - _serrator_*, 75, 82
- Merlin*, See _Falco columbarius_
- _Microtus agrestis_, 31
  - _ochrogaster_*, 15, 248, 262
  - _pennsylvanicus_*, 36, 216, 217
  - _pinetorum_, 248, 314
- Mink*, 89, 99, 248
- _Mniotilta varia_*, 37, 147
- Mole*, 283
- _Molothrus ater_*, 37, 81, 87, 88, 204, 248
- Moose*, 22, 248
- Mouse, Deer*, See _Peromyscus maniculatus_
  - Desert Pocket, 55
  - House*, See _Mus musculus_
  - Intermediate Pocket, 55
  - Jumping*, 37, 248
  - Laboratory*, 38, 50, 63, 68, 73, 101, 111, 167, 176, 223, 225, 234, 271, 280, 297, 317
  - Long-tailed Field, 31, 146, 262
  - Meadow Jumping*, 36, 37
  - Northern Grasshopper*, 204, 262
  - Old-field, 14, 248
  - Pine, 248, 314
  - Plains Pocket*, 262
  - Western Harvest, 262
  - White-footed, 98, 183, 248
  - Woodland Jumping*, 36
  - Yellow-necked Field, 31

Mule*, 302
*Mus musculus**, 15, 248, 262, 265, 266
*Mustela nivalis**, 31
  putorius, 31, 248, 302
  *vison**, 89, 99, 248
Myadestes, townsendi, 247
*Myiarchus crinitus**, 37
  tyrannulus, 278

N

*Napaeozapus insignis**, 36
Natrix erythrogaster, 85
  sipedon, 85
Neotoma albigula, 183
Newt, Smooth, 51
Nighthawk, Common*, 147, 204
Numenius americanus, 204
Nuthatch, Pygmy, 247
  Red-breasted*, 37, 247
*Nuttallornis borealis**, 37
*Nycticorax nycticorax**, 7, 66, 75, 88

O

*Odocoileus hemionus**, 6, 13, 183, 204, 206, 248, 277, 302,
  *virginianus**, 104, 206, 221, 248, 249
Oldsquaw*, 245, 248
*Onychomys leucogaster**, 204, 262
Oporornis formosus, 98
  tolmiei, 247
Oriole, Northern (Baltimore)*, 99, 178
Oryctolagus cuniculus, 248, 302
Osprey*, See *Pandion haliaetus*
Ovenbird*, 37, 87, 147, 244
Owl, Barn, 31, 53, 99, 150, 248, 322
  Boreal*, 31, 150
  Burrowing*, 81
  Eagle, 31
  Great Horned*, See *Bubo virginianus*
  Little, 150, 162, 310

Long-eared*, 31, 151, 248
Pygmy, 31
Richardson's*, See *Aegolius funereus*
Tawny, See *Strix aluco*
Tengmalm's*, See *Aegolius funereus*
Ural, 31

P

*Pandion haliaetus**, 7, 53, 99, 107, 147, 206, 236, 248, 251, 253, 269, 322
Partridge, Gray*, See *Perdix perdix*
Red-legged, 192, 248, 301
*Parula americana**, 87, 244, 248
*Parus atricapillus**, 37
caeruleus, 162
gambeli, 247, 248
*hudsonicus**, 37, 87
major, 162
*Passer domesticus**, 31, 55, 85, 87, 131, 162, 205, 225, 248, 273, 274, 302, 303
montanus, 31, 206
*Passerculus sandwichensis**, 147
*Passerella iliaca**, 37
*Pedioecetes phasianellus**, 81, 106, 143, 206, 248, 302
*Pelecanus erythrorhynchos**, 78, 24, 53, 99, 105, 206, 248, 304
occidentalis, 53, 99, 248, 322
Pelican, Brown, See *Pelecanus occidentalis*
White*, See *Pelecanus erythrorhynchos*
*Perdix perdix**, 31, 81, 99, 109, 192, 205, 206, 248, 253, 301, 302, 316
*Perisoreus canadensis**, 37, 247
Pernis apivorus, 151
Perognathus flavescens, 262
hispidus, 204, 262
intermedius, 55
penicillatus, 55
Peromyscus leucopus, 81, 98, 183, 248
*maniculatus**, 36, 37, 169, 204, 216, 217, 248, 262
polionotus, 14, 248
Petrel, Bermuda, 248, 269, 322
Pewee, Eastern Wood* 87, 98, 244
Phalacrocorax aristotelis, 53, 99, 255, 310

*auritus**, 7, 8, 53, 99, 105, 147, 206, 248, 261, 269, 289, 304
carbo, 99, 134
*Phasianus colchicus**, 1, 10, 17, 31, 40, 41, 56, 57, 58, 79, 81, 86, 88, 95, 99, 100, 103, 106, 117, 121, 127, 130, 132, 143, 163, 168, 175, 179, 180, 181, 187, 188, 192, 193, 194, 205, 209, 225, 248, 249, 269, 270, 284, 290, 294, 296, 301, 302, 303, 310, 322
Pheasant, Ring-necked*, See *Phasianus colchicus*
*Pheucticus ludovicianus**, 37, 244
*Philohela minor**, 48, 207, 322
*Phocaena phocaena**, 135
*Phoca groenlandica**, 135, 152, 248
*hispida**, 90
*vitulina**, 135, 248
Phoebe, Eastern*, 88, 322
*Pica pica**, 31, 248, 269
Pig, Domestic*, 136, 223, 225
Pigeon, Wood, 31, 99, 165, 310
Pintail*, See *Anas acuta*
*Pipilo erythropthalmus**, 37
Pipistrellus hesperus, 258
*Piranga olivacea**, 87
Pituophis melanoleucus sayi, 183, 204
sayi, 169
Pitymys pinetorum, See *Microtus pinetorum*
Plover, American Golden, 255
Semipalmated*, 206
Upland*, 204
Pluvialis dominica, 255
Pocket Gopher*, 138, 248, 300
Podiceps cristatus, 53, 248, 310
*grisegena**, 82, 304
*Podilymbus podiceps**, 66, 85
*Pooecetes gramineus**, 25, 37, 81, 204
*Porzana carolina**, 248
*Procyon lotor**, 215
Pronghorn Antelope*, 104, 204, 212, 213
*Pseudacris triseriata**, 206, 225, 248, 272
Pseudemys scripta, 85
Ptarmigan, Willow*, 206
Pterodroma cahow, 248, 269, 322

Puffin, 53, 99

Q

Quail, Coturnix, See *Coturnix coturnix*
  Japanese, See *Coturnix japonica*
Quelea, 274
Quelea quelea, 274
*Quiscalus quiscula**, 37, 85, 87, 88, 211

R

Rabbit, Cottontail, 183, 204
  Laboratory, 203, 250, 313
  New Zealand, 248, 282, 302
Racoon*, 215
Rail, King, 85
Rallus elegans, 85
Rana catesbeiana, 66, 96, 99, 225, 248, 302
  clamitans , 98
  *pipiens**, 66, 99, 156
  sylvatica, 98
  temporaria, 51, 92
*Rangifer tarandus**, 74, 248, 249
Rat, Cotton, See *Sigmodon hispidus*
  Kangaroo, 55, 204
  Laboratory*, 11, 19, 26, 49, 50, 60, 63, 69, 78, 136, 140, 154, 155, 158, 166, 176, 177, 184, 196, 203, 223, 225, 233, 246, 248, 260, 263, 288, 289, 291, 299, 302, 307, 315, 317, 323
  Whitethroat Wood, 183
Raven*, 99, 206, 248, 255
Razorbill, 54, 99, 248, 255
*Recurvirostra americana**, 304
Redpoll, Common*, 162
  Hoary*, 162
Redstart, American*, 37, 87, 147, 248
*Regulus calendula**, 36, 37, 87, 147
  *satrapa**, 36, 37, 147
Reindeer*, 74

Reithrodontomys megalotis, 262
Rissa tridactyla, 99, 248, 255, 310
Robin American*, See *Turdus migratorius*
    European, 162, 249, 269
Rook, 99, 248, 255, 269
Rostrhamus sociabilis, 182

S

Sandpiper, Pectoral*, 85
    Semipalmated*, 85
    Spotted*, 66
    Western, 85
Sapsucker, Williamson's, 247
    Yellow-bellied*, 36, 39, 87, 244, 247, 268
*Sayornis phoebe**, 88, 322
Scaup, Greater*, 16
    Lesser, See *Aythya affinis*
*Sciurus carolinensis**, 118
Scoter, Common*, 16
    White-winged*, 16
Seal, Bearded*, 90, 248
    Common (Harbour)*, 135, 248
    Fur, 4, 5, 248
    Gray, 90, 135, 248
    Ringed*, 135, 152, 248
Seedeater, Variable, 162
    Yellow-bellied, 162
*Seiurus aurocapillus**, 37, 87, 147, 244
    *noveboracensis**, 87, 147
Selasphorus platycercus, 247
*Setophaga ruticilla**, 37, 87, 147, 248
Shag, 53, 99, 255, 310
Sheep*, 9, 60, 196, 223, 225
Shoveler*, 64, 149, 248, 292
Shrew, Masked*, 37
    Short-tailed*, 36, 98, 99
    Smoky, 98
*Sialia currucoides**, 247

  *sialis**, 37, 322
Sigmodon hispidus, 14, 99, 183, 248, 262
Siskin, Pine*, 37, 87, 247
*Sitta canadensis**, 37, 247
  pygmaea, 247
Skylark, 232
Snake, Bull, 169, 183, 204
  Eastern Garter*, 66, 98, 169, 248
  Prairie Rattle, 204
  Ribbon, 85
  Water, 85
Solitaire, Townsend's, 247
*Somateria mollisima**, 248
  *sora**, 248
Sorex cinereus, 37
  fumeus, 98
Sparrow, Brewer's, 25
  Cassin's, 204
  Chipping*, 37, 87, 247
  Clay-colored*, 37
  Field, 162
  Fox*, 37
  Green-backed, 162
  House*, See *Passer domesticus*
  Lark*, 37, 204
  Lincoln's*, 247
  Savannah*, 147
  Song*, 37, 87, 247
  Tree*, 31, 162, 206
  Vesper*, 25, 37, 81, 204
  White-crowned*, 37, 206, 247
  White-throated*, See *Zonotrichia albicollis*
*Spatula clypeata**, 64, 149, 248, 292
*Speotyto cunicularia**, 81
*Spermophilus richardsonii**, 81, 204
  spilosoma, 204
  *tridecemlineatus**, 204, 262
Sphyrapicus thyroideus, 247
  *varius**, 37, 87, 244, 247, 268
*Spinus pinus**, 87, 247

*tristis**, 37
*Spiza americana**, 85, 162
*Spizella arborea**, 31, 162, 206
breweri, 25, 37
*pallida**, 37
*passerina**, 37, 87, 247
pusilla, 162
Sporophila aurita, 162
nigricollis, 162
Squirrel, Flying*, 98
Gray*, 118
Red*, 248
Richardson's Ground*, 81
Spotted Ground, 204
Thirteen-lined Ground*, 204, 262
Starling, Common*, See *Sturnus vulgaris*
*Sterna hirundo**, 66, 82, 88, 97, 248, 304
*paradisaea**, 206
sandvicensis, 99, 322
Stilt, Black-necked, 85
Streptopelia risoria, 143, 238, 248
Strix aluco, 31, 99, 150, 151, 162, 248, 310
uralensis, 31
Sturnella magna, 85
*neglecta**, 81, 204
*Sturnus vulgaris**, 21, 88, 133, 143, 148, 159, 199, 200, 201, 230
Sula bassana, 53, 248
Swallow, Barn*, 37, 206
Tree*, 248
Violet-green, 247
Swan, Mute, 31
*Sylvilagus audubon**, 183, 204

T

Tachycineta thalassina, 247
Tadarida brasiliensis, 258
Tadorna tadorna, 31
Taencopygia castanotis, 162
Talpa europea, 283

*Tamias striatus**, 36
*Tamiasciurus hudsonicus**, 248
Tanager, Scarlet*, 87
*Taxidea taxus**, 204
Teal, Blue-winged*, See *Anas discors*
  Green-winged*, 149, 247
Tern, Arctic*, 206
  Black*, 66, 88, 248
  Common*, See *Sterna hirundo*
  Sandwich, 99, 322
*Thamnophis sirtalis**, 66, 98, 169, 248
*Thomomys talpoides**, 138, 248, 292
Thrasher, Brown*, 37
Thrush, Hermit*, 87
  Song, 144, 162
  Swainson's*, 87, 147, 244
Tit, Blue, 162
  Great, 162
Toad, American*, 169
  Common, 51, 223
  Fowler's, 248, 272
  Great Plains, 204
*Totanus flavipes**, 85, 206
Towhee, Green-tailed, 247
  Ground-feeding, 178
  Rufous-sided*, 37
*Toxostoma rufum** 37
Triturus vulgaris, 51
*Troglodytes aedon**, 37, 247
  *troglodytes**, 87
Turdus ericetorum, 144, 162
  merula, 162
  *migratorius**, 37, 87, 88, 139, 206, 211, 244, 247, 248
Turkey*, 118, 248, 302
Turtles, general, 242
*Tympanuchus cupido**, 205, 248, 302
*Tyrannus tyrannus**, 37
  *verticalis**, 204
Tyto alba, 31, 53, 99, 150, 248, 310, 322

U

Uria aalge, 53, 99, 248, 310
Ursus americanus *, 23
    maritimus *, 248, 249

V

*Vanellus vanellus**, 31, 162
Veery*, 37, 87, 147
*Vermivora celata**, 37
    *peregrina**, 37, 87, 244
    *ruficapilla**, 37, 87
*Vireo gilvus**, 247
    griseus, 147
    *olivaceus**, 37, 87, 98, 147, 248, 322
Vireo, Red-eyed*, See *Vireo olivaceus*
    Warbling*, 247
    White-eyed, 147
Volatinia jacarina, 162
Vole, Bank, 146
    Meadow*, 36, 216, 217
    Pine, See *Microtus pinetorum*
    Prairie*, 15, 248, 262
    Red-backed*, 36, 37, 248
    Sagebrush, 204
    Woodland, 248, 314
*Vulpes vulpes**, 31, 72

W

Warbler, Audubon's, 247
    Bay-breasted*, 87
    Black and white*, 37, 147
    Blackburnian*, 87
    Blackpoll*, 147
    Black-throated Blue, 87, 147
    Black-throated Green*, 87
    Canada*, 37
    Cape May*, 37, 87

- Chestnut-sided*, 37
- Kentucky, 98
- MacGillivray's, 247
- Magnolia*, 87, 244
- Myrtle*, See *Dendroica coronata*
- Nashville*, 37, 87
- Orange-crowned*, 37
- Palm*, 147
- Parula*, 87, 244, 248
- Tennessee*, 37, 87, 244
- Wilson's*, 247
- Yellow*, 37
- Yellow-rumped*, See *Dendroica coronata*

Warblers, general*, 224
Waterthrush, Northern*, 87, 147
Waxwing, Cedar*, 37, 87
Weasel, Least*, 31
Weasels, general*, 98
Western pipistrelle, 258
Whale, Beluga*, 248
*Wilsonia canadensis**, 37
- *pusilla**, 247

Wolf, Timber*, 275
Woodcock, American*, 48, 207, 322
Woodpecker, Downy*, 98
- Hairy*, 37, 98, 247
- Pileated*, 37

Wren, House*, 37, 247
- Winter*, 87

Y

Yellowhammer, 31
Yellowlegs, Lesser*, 85, 206
Yellowthroat, Common*, 87, 147

Z

*Zapus hudsonius**, 36, 37
- *princeps**, 36, 37, 248

Zenaida asiatica, 248, 302
_Zenaidura macroura_*, 37, 81, 85, 88, 162, 172, 204, 248, 302
_Zonotrichia albicollis_*, 37, 87, 147, 162, 244
    _leucophrys_*, 37, 206, 247

INDEX OF COMMON AND TECHNICAL NAMES

OF PESTICIDES

Numbers following the names refer to abstract numbers in the text, not to page numbers.

Abbreviation following name indicates its most common usage:

avi. = avicide; fung. = fungicide; herb. = herbicide; insect. = insecticide;

nemat. = nematocide; rodent. = rodenticide.

Asterisks indicate pesticides recommended in publications distributed by Manitoba Department of Agriculture (as of August 1976).

Aatrex*, See Atrazine
Abar*, See Leptophos
Abate*, See 0, 0, 0', 0' Tetramethyl 0, 0'-thiodi-p-phenylenephosphorothioate
Accothion*, See Fenitrothion
Acetone, 132
Afolan*, See Linuron
Agrox (herb.), 13, 205
Agroxone*, See MCPA
Aker-tuba*, See Derris
Alanap*, See Naptalam
Aldicarb (insect.), 132
Aldrin (insect.), 13, 46, 64, 72, 77, 85, 88, 103, 104, 106, 117, 121, 129, 132, 143, 153, 156, 159, 169, 175, 187, 192, 193, 209, 228, 229, 232, 234, 249, 253, 262, 267, 269, 272, 275, 278, 285, 296, 298, 310, 322
Alfa-tox*, See Diazinon
Alkyl mercury (fung.), 31
Allethrin (insect.), 69, 267
Altacide*, See Sodium chlorate
Amicide*, See Ammonium sulfate
Aminocarb (insect.), 36, 132, 309
Aminiphenazone (insect.), 136
4-Aminopyridine (herb.), 274
Aminotriazole (herb.)*, 121, 132
Aminotriazol - Spritzpulver*, See Aminotriazole
Amiton (insect.), 136
Amitrole*, See Aminotriazole
Ammoniumamidisulfate*, See Ammonium sulfate
Ammonium sulfate (herb.)*, No information
Ammate*, See Ammonium sulfate
AMS*, See Ammonium sulfate
Aquacide*, See Diquatdibromide
Aquinite*, See Chloropicrin
Aramite (insect.)*, 121, 132, 267
Arasan*, See Thiram
Arprocarb*, See Propoxur
Arsenicals (rodent.) 36, 267
Aspon (insect.), 132
Asulam (herb.)*, 141
Asulox*, See Asulam

Asuntol*, See Coumaphos

3, A-T*, See Aminotriazole

Atrazine (herb.)*, 121, 132, 164, 206

Avadex BW*, See Trialliate

Azinphos (insect.)*, 8, 102, 121, 132, 175, 192, 204, 272, 291

Azodrin*, See Monocrotophos

Azolan*, See Aminotriazole

B

Banvel*, See Dicamba

Barban (herb.)*, No information

Basfapon*, See Dalapon

Basudin*, See Diazinon

Bay 9010*, See Propoxur

Bay 77488 (insect.), 204

Bayer 17 147*, See Azinphos

Bayer 21/199*, See Coumaphos

Bayer 25142*, See Dasanit

Bayer 37344 (insect.)*, 163

Bayer 39 007*, See Propoxur

Bayer 41831*, See Fenithrothion

Bayer L 13/59*, See Trichlorfon

Baygon*, See Propoxur

Baytex, See Fenthion

Ben.30*, See Benazolin

Benazolin (herb.)*, No information

Benzene hexachloride (BHC), See Lindane

3 - 4 - benzpyrene (insect.), 136

Benzoylprop ethyl (herb.)*, No information

BHC, See Lindane

Bichloride of Mercury*, See Mercuric Chloride

Bidrin, See Dicrotophos

O, O, - bis (4-chlorophenyl)
acetimidoyl phosphoramidothioate
(rodent. & insect.), 266, 314

Bis (dimethylthiocarbamoyl)
disulphide*, See Thiram

Blackleaf 40 (herb.), 13, 278

Blattanex, See Propoxur
Blue copperas*, See Copper sulfate
Bluestone*, See Copper sulfate
Blue Vitriol*, See Copper sulfate
Bordeaux Mix (insect.) See Copper sulfate
Brimstone*, See Sulfur
Bromacil (herb.)*, 206
Bromophos (insect.), 131
A - [2 - (2-n-butoxyethoxy) -
ethoxyl] - 4, 5-methylenedioxy
- 2 propyltoluene*, See Piperonyl butoxide
Bromoxynil octanoate (herb.)*, No information
Butacide*, See Piperonyl butoxide
Butylate*, See Ethyl diisobutyl thiccarbamate
(Butyl carbitol 6-propylpiperonyl) ether*, See Piperonyl butoxide
Butoxone SB, See 2, 4-D
2 - sec. butyl-4, 6-dinitrophenol, See Dinoseb
Butyrac*, See 2,4-D
BUX (insect.), 132

C

C - 1933*, See chloroxuron
C - 6313*, See chlorobromuron
Cadiminate*, See Cadmium succinate
Cadmium chloride (fung.)*, 132
Cadmium sebacate (fung.)*, No information
Cadmium succinite (fung.)*, 121, 132
Calciferol (rodent.), 265
Calomel*, See Mercurous chloride
Captan (fung.)*, 50, 121, 132, 267
Carbaryl (insect.)*, 13, 14, 26, 33, 37, 64, 112, 121, 132, 136, 140, 163, 178, 204,
206, 232, 253, 258, 263, 277, 278, 283, 315
Carbofuran (insect.)*, 113, 132, 274
Carbophenothion (insect.)*, 163, 272, 291
Carbon bisulfide*, See Carbon disulfite
Carbon disulfite (insect.)*, No information
Carbon tetrachloride (fung.)*, 267
Carboxin (fung.)*, No information

Carbyne*, See Barban
Casorin 133*, See Dichlobenil
Ceresan, See Methoxyethyl mercuric chloride
CHE - 1843, 132
Chemathion*, See Malathion
Chemox, See Dinoseb
Chlorax*, See Sodium chlorate
Chloranil (fung.), 267
Chlordan*, See See Chlordane
Chlordane (insect.)*, 33, 121, 129, 132, 154, 173, 175, 177, 202, 226, 250, 252, 267, 288, 298, 307
Chlorbromuron (herb)*, No information
Chlordecone (insect.), 112, 128
Chlordimeform (insect.)*, 132
Chlor - IFC*, See Chlorpropham
Chlorfenidim, See Monuron
Chlormethylfos (insect.), 132
Chlorobutynyl chlorocarbanilate*, See Barban
4 - chloro - o - cresoxyacetic acid*, See MCPA
2 - chloro - 4 - ethyl amino, - 6 - isopropyl amino - S - triazine*, See Atrazine
Chloro - IPC*, See Chlorpropham
4 - chloro - o - toloxyacetic acid*, See MCPA
N - p - Chlorophenyl - N'N' - dimethyl urea*, See Monuron
Chlorophos*, See Trichlorfon
Chloropicrin (insect.)*, 33
2 - (4 - chloro - otoloxy) proprionic acid*, See Mecoprop
Chloroxone*, See 2, 4-D
Chloroxuron (herb.)*, No information
Chlorpicrin, See Chloropicrin
Chlorpropham*, No information
Chlorthion (insect.), 267
Chlorpyrifos (insect.), 132
Ciodrin (insect.)*, No information
CIPC*, See Chlorpropham
CMPP*, See Mecoprop
CMU*, See Monuron
Copper triethanolamine (herb.)*, No information
Compound 118, See Aldrin
Compound 497, See Dieldrin

DDVF, See Dichlorvos

DDVP, See Dichlorvos

Dedevap, See Dichlorvos

Deet*, See N, N - Diethyl - m - toluamide

Delnav, See Dioxathion

Demeton (insect.)*, 40, 63, 113, 121, 267, 274, 291, 303

Derrin*, See Rotenone

Derris (insect.)*, No information

Desphedipham (herb.)*, No information

Dextrone X*, See Paraquat

Dianisyl trichloroethane*, See Methoxychlor

Diazinon (insect.)*, 40, 121, 132, 163, 175, 196, 204, 262, 263, 267, 269

Dibrom, See Naled

Dibutyl phthalate (insect.), 132

Dicamba (herb.)*, 164

Dichlobenil (herb.)*, 121, 132, 249

Dichlone (fung.), 121, 132, 267

Dichlorobenzophenone (insect.), 20, 121, 132

Dichlorprop*, No information

Dichlorvos (insect.), 64, 68, 119, 121, 132, 163, 253

Dicofol*, See Kelthane

Dicrotophos (insect.), 113, 132, 274, 303

Dieldrin (insect.), 4, 5, 7, 8, 10, 11, 13, 17, 18, 20, 21, 22, 23, 27, 33, 39, 42, 43, 44, 46, 47, 51, 53, 54, 56, 57, 58, 60, 61, 64, 70, 71, 72, 73, 75, 76, 88, 89, 91, 93, 94, 99, 100, 101, 103, 104, 106, 107, 108, 112, 120, 121, 129, 132, 135, 143, 144, 145, 146, 147, 149, 151, 152, 153, 156, 159, 165, 169, 170, 172, 173, 175, 179, 180, 181, 182, 183, 185, 186, 187, 188, 189, 190, 200, 206, 207, 209, 211, 213, 214, 215, 218, 219, 221, 227, 228, 229, 230, 231, 232, 235, 236, 237, 249, 251, 252, 253, 254, 255, 256, 257, 258, 260, 261, 264, 267, 269, 272, 275, 277, 278, 279, 280, 284, 285, 286, 293, 297, 298, 303, 310, 313, 314, 318, 319, 320, 322, 323

Dichlorprop*, No information

2 - (Diethoxyphosphinylimino - 1, 3 - dithiolane) (insect.), 274

Diethoxythiophosphoric acid ester of 2 - ethylmercaptoethanol*, See Demeton

Diethyl chloromethyl - coumarinyl thiophosphate*, See Coumaphos

0, 0-diethyl 0-(3-chloro-4-methyl-7-coumarinyl) phosphorothioate*, See Coumaphos

Diethyl p - methylsulfinylphenyl thiophosphate*, See Dasanit

Diethyl thiophosphoric acid ester of 3 chloro-4-methyl-7-hydroxycoumarin*, See Coumaphos

Diethyltoluamide*, See N, N - Diethyl - m - toluamide

N, N - Diethyl - m - toluamide*, No information

Compound 1080, See Sodium fluoroacetate

Compound B*, See Dicamba

Copper sulfate (fung. & herb.)*, 13, 267, 278

Cornox CWK*, See Benazolin

Cornox RD*, See Dichlorprop

Cotion methyl*, See Azinphos

Co-Ral*, See Coumaphos

Corrosive sublimate*, See Mercuric chloride

Coumafene*, See Warfarin

Coumaphos (insect.)*, 121, 132, 175, 274, 291

CP 23426*, See Trialliate

Crotoxuphos*, See Ciodrin

Crufomate, See Ruelene

Cryolite (insect.), 267

Cupric Sulphate*, See Copper sulphate

Cyanazine (herb.)*, No information

Cycloate (herb.)*, No information

Cyclodan*, See Endosulfan

Cygon*, See Dimethoate

Cyprazine (herb.)*, No information

Cythion*, See Malathion

Cytrol*, See Ammino triazole

D

2, 4-D (herb.)*, 6, 13, 25, 33, 43, 45, 51, 74, 109, 112, 121, 127, 130, 132, 138, 161, 164, 168, 192, 193, 194, 206, 246, 249, 253, 267, 269, 278, 300, 301

Dalapon (herb.)*, 121, 164, 253, 267

Dalmation Insect Flowers*, See Pyrethrins

Dasanit (insect.)*, 113, 121, 132, 210, 274, 291

DCMU*, See Diuron

DDD, 4, 20, 22, 33, 42, 54, 64, 70, 89, 104, 106, 120, 147, 149, 151, 159, 170, 172, 183, 187 190, 198, 200, 206, 207, 211, 218, 219, 230, 249, 252, 257, 258, 267, 269, 272, 275, 279 286, 307, 318

DDE, 4, 20, 22, 33, 42, 46, 48, 54, 70, 72, 76, 89, 93, 94, 104, 106, 107, 112, 120, 134, 145 147, 149, 151, 159, 170, 172, 173, 175, 183, 187, 190, 191, 198, 200, 206, 207, 209, 211 218, 219, 230, 249, 257, 258, 261, 267, 269, 275, 279, 284, 286, 307, 318, 320

DDT, 4, 20, 22, 33, 42, 43, 46, 51, 54, 61, 64, 70, 77, 86, 89, 91, 100, 103, 104, 106, 108, 112, 120, 129, 131, 139, 145, 147, 149, 151, 152, 153, 159, 167, 170, 172, 175, 177, 183 187, 190, 191, 193, 194, 198, 200, 206, 207, 209, 211, 218, 219, 230, 233, 234, 235, 236 237, 249, 251, 253, 257, 258, 267, 269, 272, 275, 277, 279, 280, 284, 285, 286, 298, 307 313, 318, 319

Diethyl trichloropyridyl phosphorothioate (insect.), 113, 121, 249, 303

Difenzoquat (herb.)*, No information

Dimefox (insect.), 163

Dimethoate (insect.)*, 15, 38, 49, 121, 132, 136, 163, 206, 280, 291

Dimethoxy - DT*, See Methoxychlor

Di (p - methoxyphenyl) - trichloro methyl methane*, See Methoxychlor

Dimethyldiphosphoric acid ester of N - methyl benzazimide*, See Azinphos

Dimethyl ester of 2, 2, 2 - trichloro - 1 - hydroxyethylphosphonate*, See Trichlorfon

0, 0 - dimethyl phosphorodithioate of dietary mercaptosuccinate*, See Malathion

Dinitramine (herb.)*, 267

Dinitro (herb), 298

Dinitrobutylphenol*, See Dinoseb

2, 4, Dinitro - 6 sec. - butyl phenol*, See Dinoseb

Dinoseb (herb.)*, 132, 267

Dioxathion (insect.), 121, 132, 291

Dipel (insect.), 37

Diphenamid (herb.)*, No information

Dipterex*, See Trichlorfon

Diquat (herb.)*, 121, 164, 249

Diquat dibromide (herb.)*, 132

Disulfoton (insect.)*, 121, 132, 291

Disulfuram (insect.)*, 263

Dithane D-14*, See Nabam

Dithane M-22, See Maneb

a, *a* - dithiobis (dimethylthio) formamide*, See Thiram

Diuron (herb.)*, 121, 132

DMDT*, See Methoxychlor

DMOC (fung.), No information

DMU*, See Diuron

DNBP*, See Dinoseb

DNOC (insect.), 64, 253, 267

DNOSBP*, See Dinoseb

DNSBP*, See Dinoseb

Dowco 132*, See Ruelene

Dowpon*, See Dalapon

2, 4-DP*, See Dichlorprop

Drop leaf*, See Sodium chlorate

DTMS*, See Kelthane

Dupont 4179*, See Methomyl

Dursban, See Diethyl trichloropyridyl phosphorothioate

Dyanap formulation*, See Naptalam

Dyfonate (insect.), 121, 132

Dylox*, See Trichlorfon

Dymid*, See Diphenamid

E

E 1059*, See Demeton

E 3314*, See Heptachlor

EDB*, See Ethylene dibromide

Embutox, See 2, 4-D

Endosulfan (insect.)*, 64, 113, 121, 132, 192, 223, 285

Endothal*, See Endothall

Endothall (herb.)*, No information

Endrin (insect.), 19, 33, 49, 64, 77, 99, 101, 106, 113, 118, 120, 121, 132, 143, 153, 155, 173, 175, 184, 187, 209, 211, 213, 216, 217, 232, 249, 253, 257, 259, 261, 267, 271, 272, 275, 285, 314, 322

Enide*, See Diphenamid

ENT 7796*, See Lindane

ENT 17957*, See Coumaphos

ENT 19762*, See Trichlorfon

ENT 20218*, See N, N, Diethyl - m - toluamide

ENT 23, 708*, See Carbophenothion

EP 452*, See Phenmedipham

EPN, 13, 63, 121, 132, 175, 267, 278, 291, 303

Eptam*, See EPTC

EPTC*, 164

Estaprop (herb.)*, No information

Ethion (insect.), 33, 64, 132, 163, 291

S-1, 2-bis (ethoxycarbonyl) ethyl - 0, 0 - dimethyl thiophosphate, See Malathion

Ethyl - diisobutyl thiocarbamate (herb.)*, No information

Ethylene bromide*, See Ethylene dibromide

Ethylene dibromide (insect.)*, No information

β - Ethylmercaptoethyl diethyl thionophosphate*, See Demeton

Experimental Insecticide 269, See Endrin

Experimental Insecticide 4049*, See Malathion

Experimental Insecticide 7744*, See Carbaryl

Experimental Insecticide 12, 880*, See Dimethoate

F

Far-go*, See Trialliate

Fenac (herb.), 121

Fenchlorphos, See Ronnel

Fenitrothion (insect.)*, 34, 36, 37, 119, 121, 132, 175, 204, 224, 245, 249, 268, 309

Fenoprop (herb.)*, 121, 135, 164, 249, 272
Fensulfothion*, See Dasanit
Fenthion (insect.), 4, 63, 121, 132, 274, 291, 303
Fenuron*, See Dasanit
Ferkethion*, See Dimethoate
Flour sulfur*, See Sulfur
Flowers of sulfur*, See Sulfur
Folex (insect.), 63, 291
Folithion*, See Fenitrothion
Fostion MM*, See Dimethoate
Fungicides (unspecified), 110
Furadan*, See Carbofuran
FW - 293*, See Kelthane

G

G - 24480*, See Diazinon
G 27692*, See Simazine
G 31435, See Prometon
Gallotox*, See Phenylmercuric acetate
Gammexane See Lindane
Gammopaz*, See Lindane
Gardona, See Tetrachlorvinphos
Garrathion*, See Carbophenothion
Gebutox*, See Dinoseb
Gesaprim*, See Atrazine
Gesatop*, See Simazine
Glyphosate (herb.)*, No information
Gophacide, See 0, 0 - bis (4-chlorophenyl) acetimidoyl phosphoramidothioate
Gramoxone*, See Paraquat
Ground rock sulfur*, See Sulfur
Gusathion*, See Azinphos
Guthion*, See Azinphos

H

HCH (hexachlorocyclohexane), See Benzene hexachloride
HEOD, See Dieldrin

Heptachlor (insect.)*, 33, 41, 64, 72, 77, 104, 106, 112, 121, 132, 153, 155, 156, 158, 165, 174, 209, 229, 249, 253, 255, 262, 267, 272, 275, 285, 310, 322

Heptachlor epoxide (insect.), 20, 21, 24, 48, 70, 72, 89, 93, 94, 103, 104, 106, 120, 155, 170, 172, 187, 190, 200, 209, 213, 218, 219, 230, 252, 254, 255, 257, 269, 275, 310

3, 4, 5, 6, 7, 8, 8 heptachlorodicyclopentadiene*, See Heptachlor

Herbicides (unspecified), 9, 28, 29, 52

Hexachlorobenzene (HCB) (fung.), 97, 132, 230, 252, 308, 319

1, 2, 3, 4, 7, 7 - Hexachlorobicyclo - 2, 2, 1 hepten - 5, 6 - bisoxymethylene sulfite*, See Endosulfan

Hg, See Mercury

Hinosan (fung.), 132

Hydrothol 191 (insect.), 272

Hyvar X Bromacil Weed Killer*, See Bromacil

I

Imidan (insect.), 121, 132

Insecticides (unspecified), 3, 52, 92, 110, 160

Insect Powder*, See Pyrethrins

Isobornyl thiocyanoacetate (insect.), 267

Isocil*, See Bromacil

2 - Isopropoxyphenyl methylcarbonate*, See Propoxur

2 - Isopropoxyphenyl N-methylcarbonate*, See Propoxur

K

Karbutilate (herb.)*, No information

Karmex*, See Diuron

Kelthane (insect.)*, 64, 121, 132, 153, 202, 269

Korlan*, See Ronnel

Kuron*, See Fenoprop

Kurosal*, See Fenoprop

Kwik - kil, See Strychnine

L

L - 34 314*, See Diphenamid

L - 36352*, See Trifluralin

Lannate*, See Methomyl
Lead arsenate (insect.), 132
Legume - extra*, See Benazolin
Leptophos (insect.)*, 132
Leg Cornox*, See Benazolin
Lindane (insect.)*, 21, 24, 41, 53, 55, 59, 64, 72, 75, 83, 86, 89, 99, 104, 106, 121, 129, 132, 151, 153, 156, 157, 166, 167, 187, 200, 206, 209, 213, 229, 230, 232, 233, 249, 253, 255, 267, 269, 270, 271, 272, 275, 285, 289, 298, 310, 313, 317
Linuron (herb.)*, 132
Liquiphene*, See Phenylmercuric acetate
Lorox Linuron Weed Killer*, See Linuron

M

M - 140*, See Chlorodane
Malaspray*, See Malathion
Malathion(insect.)*, 13, 26, 33, 63, 64, 78, 98, 111, 121, 132, 136, 163, 175, 204, 253, 267, 269, 272, 278, 280
Malix*, See Endosulfan
Maloran*, See Chlorbromuron
M & B 9057*, See Asulam
M & B 10,731 Buctril*, See Bromoxynil octanoate
Maneb (fung.)*, No information
Manzate Maneb fungicide*, See Maneb
Marlate*, See Methoxychlor
Matacil, See Aminocarb
MB 2878*, See 2, 4-D
MCP*, See MCPA
MCPA (herb.)*, 164
MCPB salts (herb.)*, 121, 132
MCPP*, See Mecoprop
MEB*, See Maneb
M_nEBD*, See Maneb
Mecoprop (herb.)*, No information
Mecoturf*, See Mecoprop
Mediben*, See Propoxur
Mema R.M. (fung.), 13, 205, 278
Mephanac*, See MCPA
Mercaptophos*, See Demeton

Mendrin, See Endrin
Mercaptodimethur (insect.), 274
Mercuram*, See Thiram
Mercuric chloride (fung.)*, 96, 132
Mercurous chloride (herb. & fung.)*, No information
Mercury, 2, 12, 16, 20, 24, 29, 32, 48, 75, 81, 82, 90, 93, 95, 105, 107, 110, 114, 120, 122, 123, 124, 125, 126, 134, 146, 149, 150, 152, 171, 172, 199, 201, 242, 245, 284, 292, 294, 304, 305, 306, 316, 320
Mesurol (insect.), 132
Meta*, See Metaldehyde
Metabrom*, See Methyl bromide
Meta - Delphene*, See N,N - Diethyl - m - toluamide
Metafume*, See Methyl bromide
Metaldehyde (molluscicide)*, No information
Metasystox R, See Oxydemeton - methyl
Metathion E-50*, See Fenitrothion
Metham sodium (fung.), 121
Methiocarb, See Mercaptodimethur
Methomyl (insect.)*, 111, 121, 132
Methoxone*, See MCPA
2 methoxy - 4, 6 - bis (isopropylamino) - S - triazine*, See Prometon
Methoxyethyl mercuric chloride (fung.)*, 13, 112, 121, 132, 173, 175, 205
Methoxychlor (insect.)*, 26, 64, 77, 121, 129, 132, 139, 202, 211, 225, 249, 267, 272, 275, 307
1 Methylbenzyl 3 - (dimethoxyphosphinyloxo) isocrotonate*, See Ciodrin
Methyl bromide (insect.)*, No information
2 - Methyl - 4 - chlorophenoxyacetic acid*, See MCPA
Methyl demeton (insect.)*, 291
Methyl mercury (fung.), 30, 62, 79, 80, 238, 271, 321
S - Methyl - N - [(methylcarbomoyl) oxy] thioacetimidate*, See Methomyl
N - Methyl - α - napthyl urethane*, See Carbaryl
Methyl nitrophos*, See Fenitrothion
Methyl parathion (insect.), 33, 55, 121, 132, 211, 262, 291
Methyl trithion (insect.), 132
Metrifonate*, See Trichlorfon
Mevinphos (insect.), 132, 163, 291
Mexacarbate (insect.), 13, 113, 121, 132, 278, 303
Mirex (insect.), 48, 116, 121, 128, 132, 172, 207, 219, 252
Mobam (insect.), 13, 278

Mocap (nemat.), 121, 132
Molinate (herb.), 272
Monobromomethane*, See Methyl bromide
Monocrotophos (insect.)*, 113, 132, 232, 274, 303
N - Monomethylamide of 0, 0 - dimethyldithiophosphorylacetic acid*, See Dimethoate
Monuron (herb.), 121, 132
Morsodren, See Panogen
Mouse - tox, See Strychnine
Moxie*, See Methoxychlor
Muscatox*, See Coumaphos

N

Nabam (fung.), 121, 132
Naled (insect.), 121, 132
Nankor*, See Ronnel
1 Naphtyl - N - methyl carbamate*, See Carbaryl
Naptalam (herb.)*, No information.
Naugatuck Det, See N, N - Diethyl - m - toluamide
Neguvon (insect.), See Trichlorfon
Nemacur (nemat.), 132
Nemax*, See Chloropicrin
Neocidol/Nucidol*, See Diazinon
Neotran (insect.), 267
NIA 5273*, See Piperonyl butoxide
NIA 5462*, See Endosulfan
NIA 10242*, See Carbofuran
NIA 11092, See Karbitulate
Nicotine (insect.), 64, 267
Nicouline*, See Rotenone
Nitrochloroform*, See Chloropicrin
Nogos, See Dichlorvos
Nomersan*, See Thiram
Norea, 263
Nuvan, See Dichlorvos

O

Octachlor*, See Chlordane

1, 2, 4, 5, 6, 7, 10, 10 - Octachloro - 4, 7, 8, 9 - tetrahydro - 4, 7 - endomethyleneindane*, See Chlordane

Octachlorodihydroicyclopentadiene*, See Chlordane

Octalene, See Aldrin

Octa - Klor*, See Chlordane

Octalox, See Dieldrin

Organochlorine Pesticides (unspecified), 133, 150, 186

Orthene, 309

Orthocide 406*, See Captan

Ortho 11775 (insect.), 132

Ovatran, See Ovex

Ovex (insect.), 267

Oxydemeton - methyl (insect.), 64, 121, 132, 303

P

Panogen (insect.), 121, 132, 205

Panoram D 31, See Dieldrin

Paradichlorobenzene (insect.)*, 33

Paraoxon (insect.), 136

Paraquat (herb.)*, 33, 121, 132, 164, 193, 206, 249, 272

Parathion (insect.), 13, 33, 55, 59, 62, 63, 64, 112, 113, 115, 121, 132, 136, 163, 175, 192, 193, 200, 211, 249, 253, 267, 272, 274, 278, 291, 298, 303

Paris Green (insect.), 121, 135

PCB, 20, 44, 48, 54, 76, 93, 105, 107, 108, 116, 134, 172, 190, 191, 200, 207, 219, 230, 261, 275, 284, 313, 318, 319, 320

PEBC*, See Pebulate

Pebulate (herb.)*, No information

Pentachlorophenol (fung.), 33, 121, 152

Perchloride of Mercury*, See Mercuric chloride

Perthane (insect.), 121, 152

PHC*, See Propoxur

Phenmedipham (herb.)*, No information

Phenthoate (insect.), 132

3 - (1' - phenyl - 2' - acetylethyl) - 4 - hydroxycoumarin*, See Warfarin

Phenylmercuric acetate (fung.)*, 1, 132

Phix*, See Phenylmercuric acetate

Phorate, 40, 121, 132

Phosdrin, See Mevinphos

Phosphamidon (insect.), 35, 64, 87, 121, 132, 175, 253

Phosvel*, See Leptophos

Phygon, See Dichlone

Picfume*, See Chloropicrin

Picloram (herb.)*, 121, 132, 164, 203, 222, 299

Piperonyl butoxide (insect.)*, 272

PMA*, See Phenylmercuric acetate

PMAC*, See Phenylmercuric acetate

PMAS*, See Phenylmercuric acetate

Polychlorinated biphenyls, See PCB

Pomarsol*, See Thiram

Potassium dichromate (herb.), 132

PP 148*, See Paraquat

PP 910*, See Paraquat

Pramatol*, See Prometon

Precipitated sulfur*, See Sulfur

Premerge*, See Dinoseb

Primatol*, See Simazine

Princep*, See Simazine

Prometon (herb.)*, No information

Propoxur (insect.)*, 13, 113, 121, 132, 163, 204, 278, 303

Pyrethrins (insect.)*, 69, 132, 193, 247, 267, 273

Pyrethrum*, See Pyrethrins

R

R - 1313*, See Carbophenothion

R - 1608*, See EPTC

R - 1910*, See Ethyl diisobutyl thiocarbamate

R - 2061*, See Pebulate

R - 2063*, See Cycloate

Radapon*, See Dalapon

RD 406*, See Dichlorprop

RD 7693*, See Benazolin

Reglone*, See Diquat dibromide

Resitox*, See Coumaphos

Rodenticides (unspecified), 142

Ro - Dex, See Strychnine

Rogor*, See Dimethoate

Ro - neet, See Cycloate

Ronnel (insect.)*, 63, 64, 291

Rotenone (insect.)*, 132, 267, 298

Roxion*, See Dimethoate

Ruelene (insect.)*, 99, 163

S

S 767*, See Dasanit

S 874*, See Barban

S 1102A*, See Fenitrothion

S 4075*, See Phenmedipham

S 5660*, See Fenitrothion

Salvo*, See 2, 4-D

Sarolex*, See Diazinon

Schering 4072*, See Phenmedipham

Schering 4075*, See Phenmedipham

Schering 30584*, See Phenmedipham

Schardan (insect.), 63, 64, 267, 291

2 - Sec. - butyl - 4, 6 - dinitrophenol*, See Dinoseb

Sendran*, See Propoxur

Sevin*, See Carbaryl

Shed - a - leaf "L"*, See Sodium chlorate

Silvex*, See Fenoprop

Simazine (herb.)*, 84, 121, 132, 193, 206

Sodium arsenate (herb.), 33, 112, 249

Sodium borate (herb.)*, No information

Sodium chlorate (herb.)*, No information

Sodium 2, 2 - dichloropropionate*, See Dalapon

Sodium fluroracetate, 113, 267, 303

Spectracide*, See Diazinon

Spergon, See Chloranil

SR - 406*, See Captan

Starlicide (Avi.), 121, 132

Strobane, See Terpene polychlorinates

Strychnine (rodent.), 33, 137, 206, 267, 303

Subchloride of mercury*, See Mercurous chloride

Sublimed sulfur*, See Sulfur

Sulfur*, No information

Sumithion*, See Fenitrothion

Sutan *, See Ethyl - diisobutyl thiocarbamate

Systox*, See Demeton

T

2, 4, 5-T, 74, 121, 127, 130, 132, 161, 164, 192, 193, 206, 249, 253, 267, 301

Tag HL 331*, See Phenylmercuric acetate

Tandex*, See Karbutilate

TCA salts (herb.)*, No information

TDE, See DDD

Telodrin, 13, 202, 293, 322

Telvar*, See Monuron

Tenoran*, See Chloroxuron

TEPP (insect.), 33, 253, 267, 298

Terpene polychlorinates (insect.), 121, 267, 285

Terracur P*, See Dasanit

Tersan*, See Thiram

Tetrachloromethane*, See Carbon tetrachloride

Tetrachlorvinphos (insect.), 131, 132

Tetradifon (insect.), 121, 132

Tetraethylliad (insect.), 112

0, 0, 0', 0' Tetramethyl 0, 0' thiodi - p - phenylene phosphorothioate (insect.)*, 121, 131, 132 303

Thallium (rodent), 33, 267

Thimul*, See Endosulfan

Thiodan*, See Endosulfan

Thiofor*, See Endosulfan

Thionazine (insect.), 121, 132

Thiram (fung.)*, 118, 121, 132, 263, 267

Thylate (fung.)*, See Thiram

Tillam*, See Pebulate

TMTD*, See Thiram

TMTDS*, See Thiram

Tordon*, See Picloram

Toxaphene (insect.), 13, 33, 113, 121, 132, 204, 249, 253, 258, 267, 269, 272, 277, 278, 285, 298

2, 4, 5 TP, See Fenoprop

Treflan EC*, See Trifluralin

Triallate (herb.)*, No information

Trichlorfon (insect.)*, 119, 121, 132, 175, 178, 267

Trichloroacetic acid *, See TCA salts
2, 2, 2 - trichloro - 1, 1 - di - (4 - Chlorophenyl ethanol)*, See Kelthane
N - Trichloromethylethiocyclohex - 4 - ene 1, 2 dicarboxyimide*, See Captan
N - Trichloromethylthiotetrahydro phthalimide*, See Captan
2, 3, 6 - Trichlorophenylacetic acid (herb.), 272
Tricornox *, See Benazolin
Trieste Flowers*, See Pyrethrins
Trifluralin (herb.)*, 272
Trithion*, See Carbophenothion
Trolene*, See Ronnel
Tuads*, See Thiram
Tuba - root*, See Derris
Tubatoxin*, See Rotenone
Tugon*, See Trichlorfon

U

Unden*, See Propoxur

V

Vancida TM - 95*, See Thiram
Vapam (fung. & nemat.), 132
Vapona, See Dichlorvos
VCS - 506*, See Leptophos
Vesicol 58 - CS - 11*, See Dicamba
Velsicol 104*, See Heptachlor
Vesicol 1068*, See Chlordane
Viozene*, See Ronnel
Vitavox*, See Carboxin

W

W.A.R.F. 42*, See Warfarin
Warfarin (rodent.)*, 33, 206, 265
Weedar*, See 2, 4-D
Weedazol*, See Amitrole
Weedol*, See Paraquat
Weedone*, See 2, 4-D

Z

Zectran, See Mexacarbate
Zinc phosphide (rodent.), 33
Zineb (fung.), 267
Ziram (fung.), 267
Zoocoumarin*, See Warfarin

58 - 12 - 315*, See Propoxur